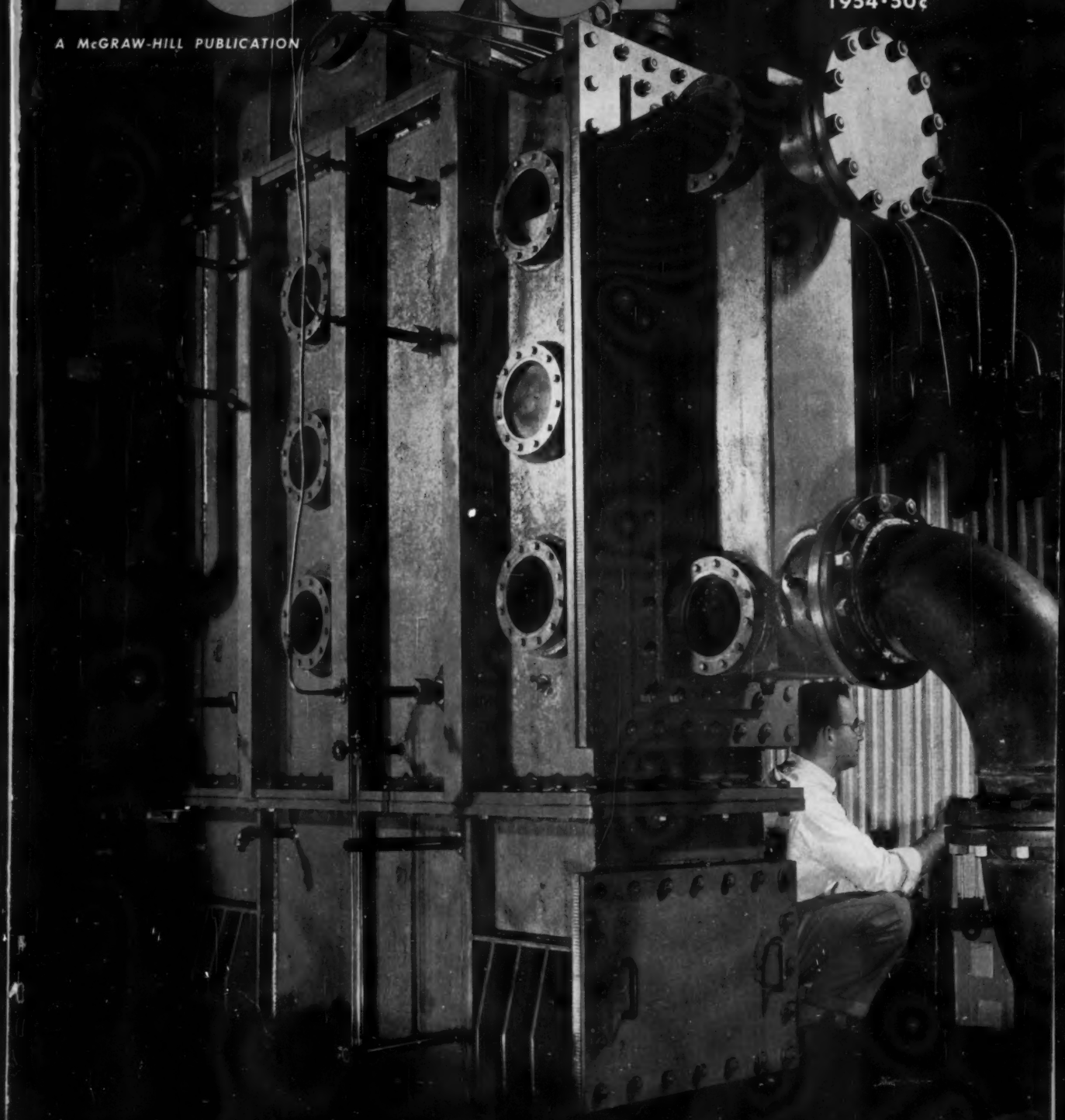
GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

# Power

A McGRAW-HILL PUBLICATION

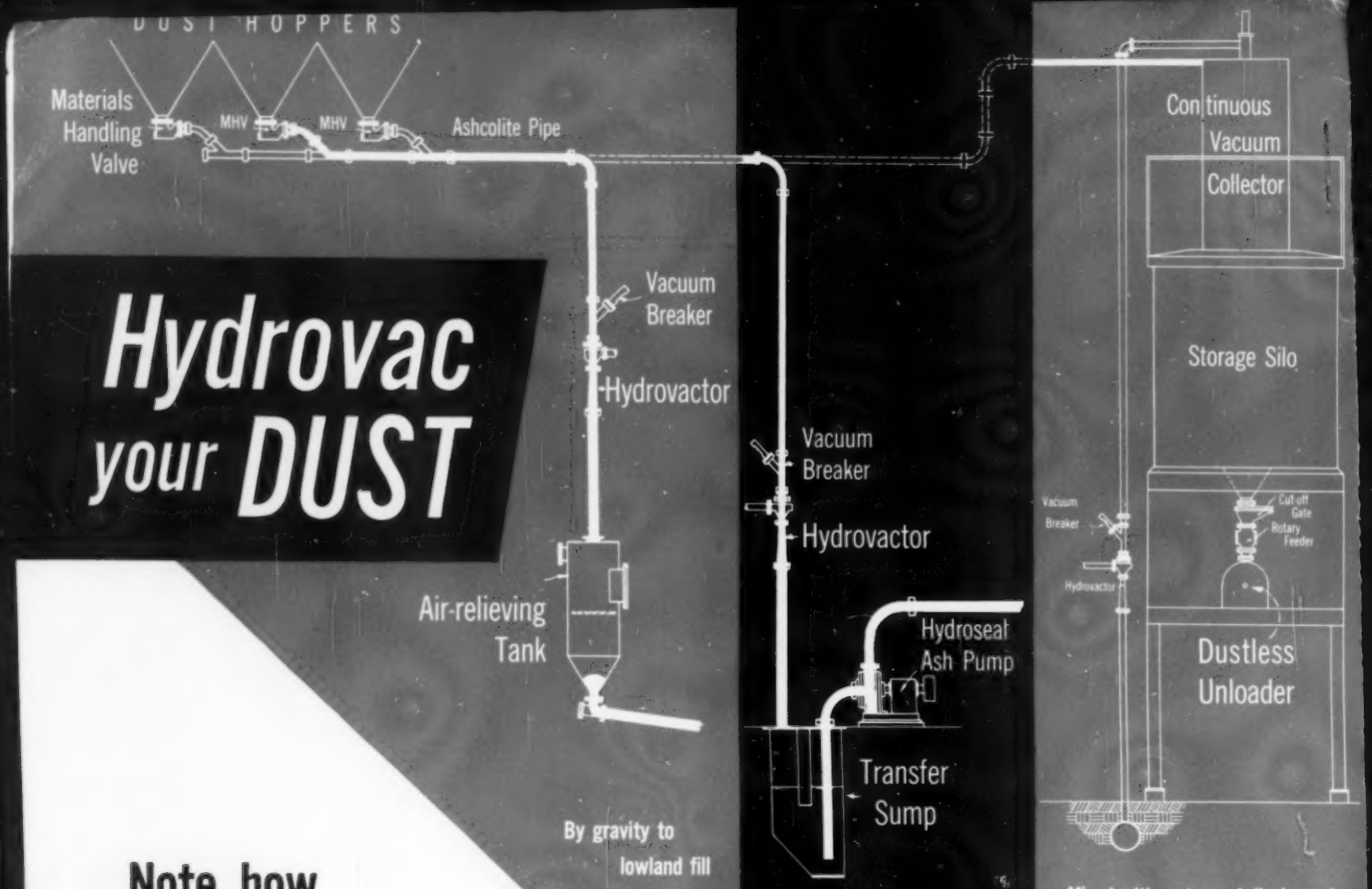
**Modernization Awards p 100**

February
1954 • 50¢



**Condenser Problems Studied in Test Unit—p 108**

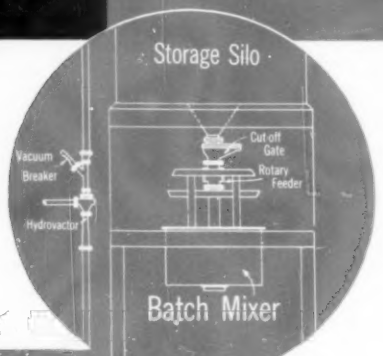
# Hydrovac your DUST




## Note how HYDROVAC can meet your disposal need

**Every** Hydrovac system provides the most efficient transportation of dust yet devised. Versatility of disposal makes Hydrovac adaptable to the conditions at your plant. Its long-range economy is another reason for your changing over to Hydrovac — and lasting satisfaction.

*For detailed information, write today for Catalog No. 752.*




Proper mixture of dust and water, automatically controlled, batch by batch, and unloaded into truck or railroad car

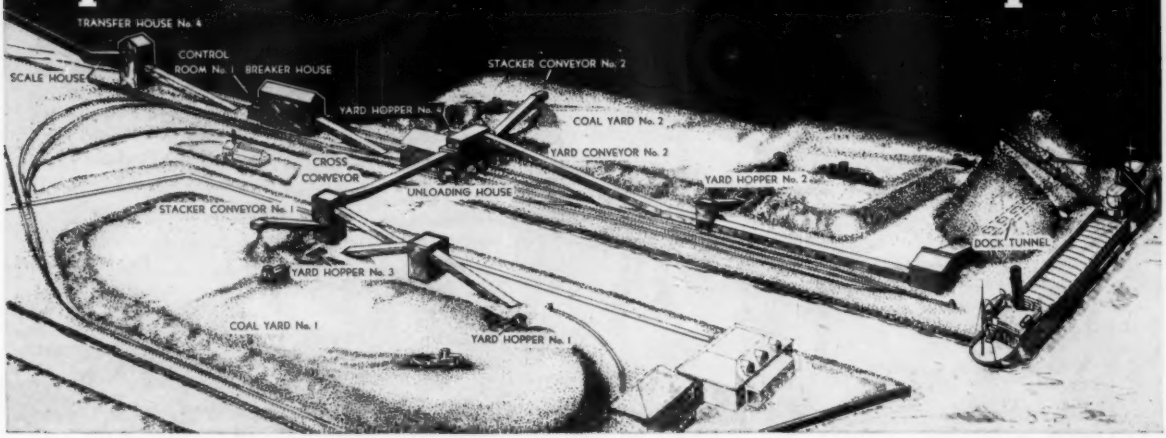
**THE ALLEN-SHERMAN-HOFF CO.**

Dept. A—259 E. Lancaster Ave., Wynnewood, Pa.
*Offices and Representatives in Principal Cities*

# HYDROJET (hydraulic) ASH HYDROVAC (pneumatic)

## materials handling systems

# Versatile Link-Belt coal handling system provides push-button control of 2000 tph




## Detroit-Edison achieves great flexibility at new Conners Creek station

WHEN the existing low-pressure steam plant at Detroit Edison's Conners Creek station was augmented by a new high-pressure plant, coal handling problems were multiplied. In addition to the extra capacity needed, the two plants use different types of coal.

Here's what the Link-Belt coal handling system had to accomplish:

(1) Receive approximately 1.3 million tons of coal a year by boat and rail.

(2) Handle and keep separate two different kinds of coal.

(3) Store coal in two separate yards or feed directly to power plants.

(4) Maintain centralized control of electrically interlocked system.

(5) Provide continuous, automatic weighing and sampling.

(6) Hold cost per ton handled to the lowest possible figure.

That's a big order. Yet all these requirements have been fulfilled with top efficiency. Two types of coal are unloaded, stored, reclaimed and fed to the plants in any one of eleven sequences the operator selects. Handling costs are among the industry's lowest.

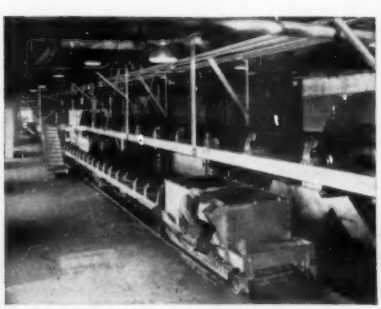
Whether your problem is simple or complex, you, too, will find Link-Belt the best source for your coal handling needs. For all the facts, see your nearby Link-Belt representative or write for Book 2410.

**LINK-BELT**

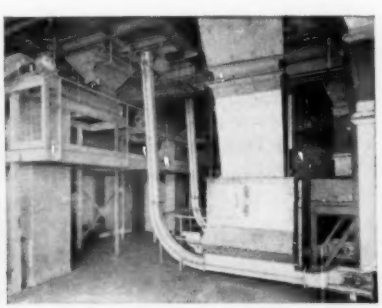
**COAL HANDLING EQUIPMENT**

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13,376

Under coal dock, Link-Belt reclaim conveyor is fed by eight belt feeders.

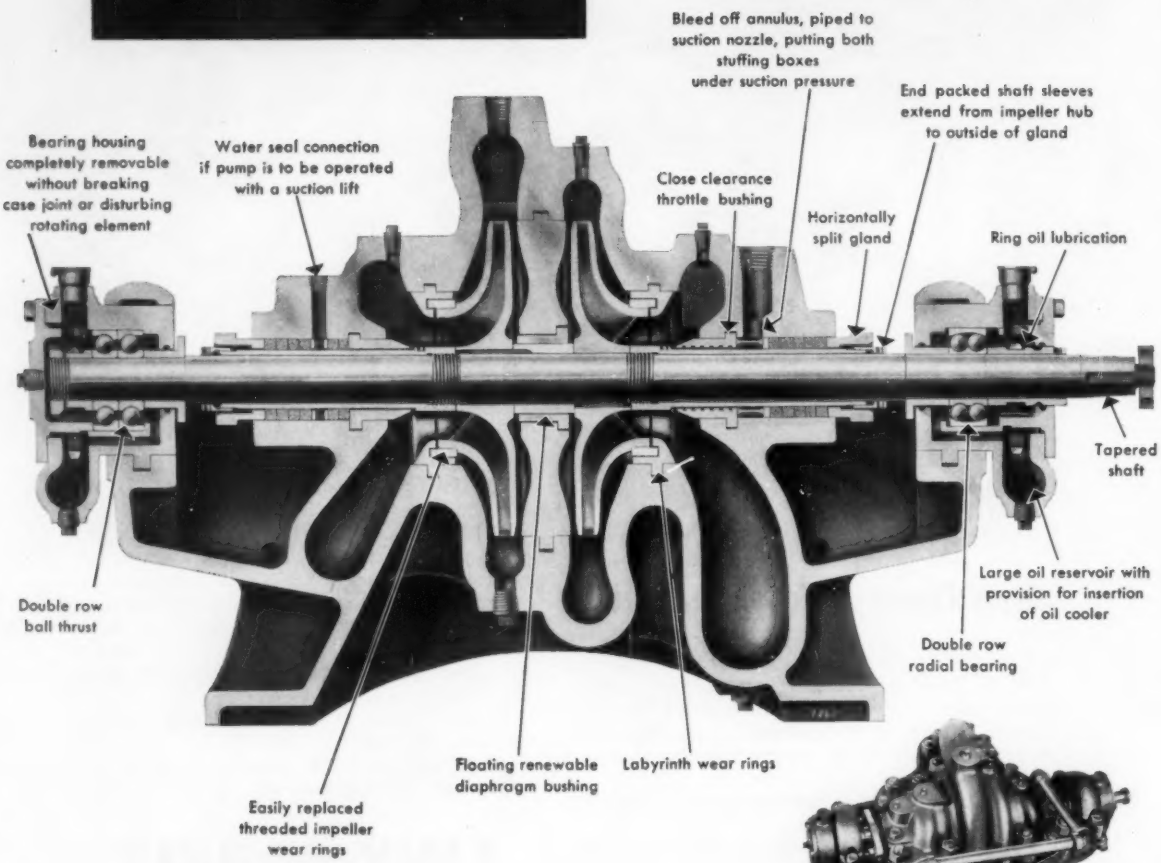


Belt conveyor delivers to reversible shuttle feeder over low-pressure plant bunkers.



Two Bulk-Flo conveyor-elevators deliver coal to crushers for continuous sampling.

# DE LAVAL
## TWO-STAGE
## HORIZONTAL PUMPS


Bleed off annulus, piped to suction nozzle, putting both stuffing boxes under suction pressure
End packed shaft sleeves extend from impeller hub to outside of gland
Bearing housing completely removable without breaking case joint or disturbing rotating element
Water seal connection if pump is to be operated with a suction lift
Close clearance throttle bushing
Horizontally split gland
Ring oil lubrication
Tapered shaft
Double row ball thrust
Large oil reservoir with provision for insertion of oil cooler
Double row radial bearing
Floating renewable diaphragm bushing
Labyrinth wear rings
Easily replaced threaded impeller wear rings

# *These 14 Design Features Insure Long-range, Low-cost Service*

Look at the important design features highlighted in this cross-section. You will clearly see why De Laval 2IS-2KS Two-Stage Horizontal Pumps are designed to give you long, dependable, highly efficient service. ● These pumps are precision-made to quality manufacturing standards. They are available in capacities from 75 to 3,000 gpm, sizes from 2″ to 8″ discharge and heads to 750 feet. Write for Bulletin 1501 giving complete data.

**DE LAVAL** *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY

*815 Nottingham Way, Trenton 2, New Jersey*

DL-839

# Power

FEBRUARY 1954 • VOLUME 98 NUMBER 2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**Print order this issue: 47,380**


FEBRUARY 1954 POWER Vol. 98—No. 2

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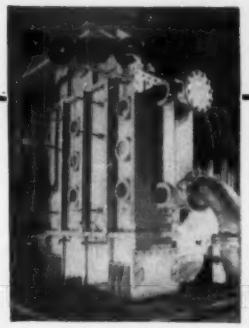


**TESTING** full-scale major power equipment like condensers is important to designers. This tells them how well their ideas pan out in practice. But the huge quantities of water and steam flows needed to do any shop testing over the full range make it difficult. Once a condenser is put in harness it can't be easily scheduled to run a test.

To get around the troubles of full-scale testing, Allis-Chalmers condenser engineers designed the testing condenser shown on our cover. Rushen Wilson and Howard Feist tell us on page 108 how this unit will be used to get faster answers on new ideas in condenser arrangements and materials. Flexibility in the layout of the testing unit allows many experiments that would be hard and expensive to make on a full-size central-station surface condenser.

### *Next month . . .*

■ How do you handle 300 million gpd of water when it's needed for cooling, process and makeup? This flood of water for such varied needs calls for special treatment and handling. Hydrotechnic Corp tells us in March how they laid out such a job for the Fairless Works of United States Steel Co.

■ Gaskets seem to be only minor items in a pipeline or for cover plates on machinery. But if you don't choose the right materials or if you install them wrong, you can come to grief in a short time with leaks and shutdowns.

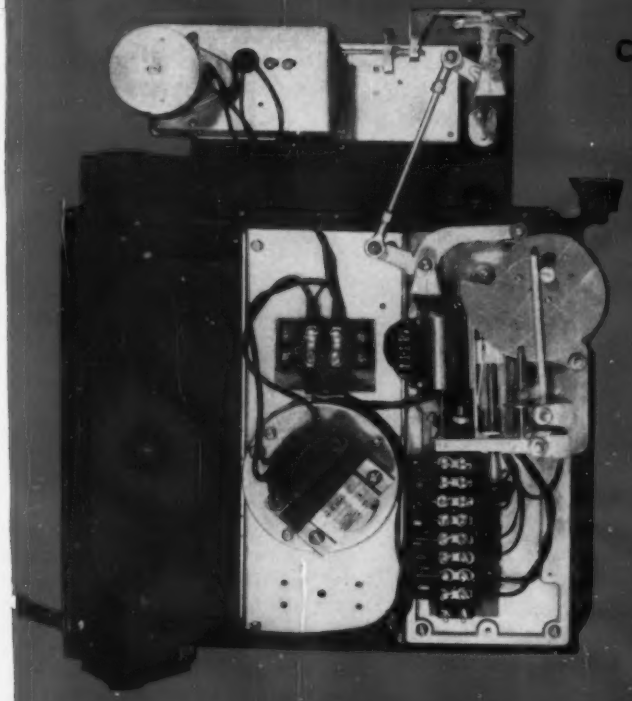
■ Our 20-page special report in March helps you get on the right track in selecting and setting up gaskets. Rising pressures and temperatures and a wide variety of fluids to handle call for just the right sealing method.

■ The wrap-up of indoor-outdoor placement of central-station equipment given in January will be followed by a detailed table for the individual new plants in next month's issue.

### *. . . and future months*

■ Steam turbines can be tailored to fit in almost any steam and power situation. Look for our story on a dual-pressure automatic-extraction turbine, taking in throttle steam at two different pressures as needed.

# a new electronic flow meter!



Choice of 3 mercury-less transmitters

Hays Barton flow or differential transmitter

Hays differential transmitter

Hays liquid level transmitter

continuous integration —no creep at zero

unaffected by normal voltage, frequency and temperature changes

electronic operation provides high speed and greater accuracy

3 to 1 range calibration at recorder

## HAYS Electronic Flow Meter

Since the circuit is of the electronic null-balance type, it is unaffected by normal voltage and frequency variations. Also, neither temperature variations nor reasonable length of transmission lines affect the calibration of the instrument.

The *pen-drive motor* is built for reversing duty. Normal variations in voltage and frequency have no noticeable effect on its operation.

The *integrator* is continuous in operation and simple in mechanical construction. A micrometer zero adjustment for calibration is easily accessible.

*Indicators* can be calibrated to read directly in rate-of-flow or other factors as desired.

*Write today for full information on the Hays Electronic Flow Meter Bulletin 52-1074-222.*

Automatic Combustion Control
Boiler Panels
Veriflow Meters and Ventrol
Gas Analyzers • Draft Gages
Combustion Test Sets • $CO_2$ Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
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THE hays CORPORATION

MICHIGAN CITY 3, INDIANA

# Power

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## First issue of STEAM is worth $25

To the first reader who sends us Vol 1, No. 1 of the magazine *Steam*, predecessor of POWER, we'll pay $25. We're trying to establish the founding date. We don't know it exactly, but it'll be between 1880 and 1882.

That's a long time ago, so take a look in grandpa's attic and talk with some of your retired engineer friends. It'll be worth your while and you'll be doing us a real service. If you turn up a copy of the first issue, but don't want to part with it, we'll take a photostat of the first page, showing the volume, number and date. Send it to the Editor of Power, 330 West 42nd Street, New York 36, N. Y.

## ...lines and bylines

M Sigmund

**COOPERATION** reaches its highest level when maker and users of equipment can get together and decide the most useful line to make available. M Sigmund tells how British plant engineers worked with his company, Sigmund Pumps Ltd, to develop two lines of industrial pumps with interchangeable impellers, p 102.

Sigmund was educated in Brünn, Czechoslovakia and graduated in 1930 as a Mechanical Engineer (design and production). After doing considerable work in designing and developing submersible pumps and registering numerous patents in Czechoslovakia, he became managing director of Sigmund Pumps Ltd of England in 1938 with factories at Gateshead, England.

He is a member of the American Society of Mechanical Engineers, Institute of Mechanical Engineers, Institute of Production Engineers, Institute of Industrial Administration. He relaxes by pursuing the hobbies of photography and foreign travel, which combine easily.

**POWER** is happy to announce two staff additions and one promotion: Stoddard Waldron joined POWER as Assistant Editor on Nov 23, 1953. Howard Kallen, also Assistant Editor, started work on Jan 4 of this year. Althea Thornton was promoted from Editorial Assistant to Assistant Editor on Jan 1. For the new lineup, largest and best equipped in POWER's history, see masthead at upper left corner of this page.

S S Waldron

STODDARD STONE WALDRON. "Tod" Waldron is the son of Major General A W Waldron. After graduating from the U.S. Naval Academy in 1945 he served as an Engineering Officer two years.

In 1947, he joined the Marine Division of Babcock & Wilcox. His work was in the design and development of boilers, also field testing and field studies of boilers and auxiliaries.

Tod's second tour of duty in the Navy extended from July 1951 to November 1953, shortly before he joined us.

H P Kallen

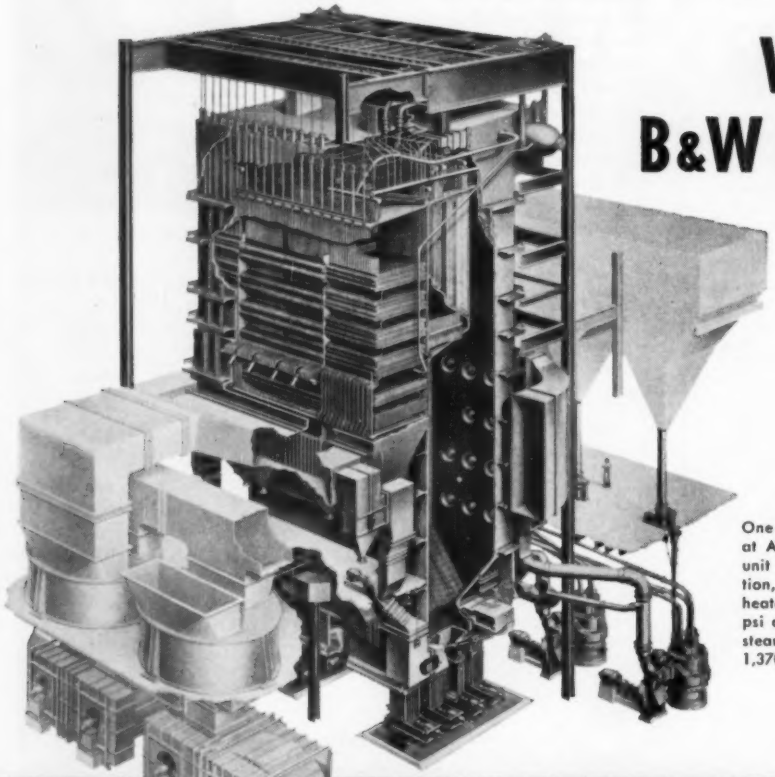
HOWARD PAUL KALLEN. After two years with Westinghouse, Steam Turbine Division, Howard served with the U.S. Army Ordnance Corps until September 1946. As Service Officer he supervised a maintenance section in Italy.

Then came four years at Cornell where he was a staff editor on the *Cornell Engineer*. After graduating with honors in Mechanical Engineering, he worked first with the Hyatt Division of General Motors, then with J G White Engineering Corp. With Hyatt he was a process engineer, developing and testing forging-press hydraulic systems. His work with J G White included power-plant instrumentation, heat-balance calculations, piping design, pipeline stress analysis and economic studies of new equipment.

ALTHEA SCHAFFER THORNTON. Althea Thornton is a Mechanical Engineering graduate of Pennsylvania State College. After several years' engineering office experience she came to POWER as an Editorial Assistant in August 1951. As Assistant Editor she will continue to handle technical articles, reader letters in "Arguments," and special assignments from the Executive Editor on various editorial projects.

# Astoria Station

## With More B&W Pressure-Fired Boilers



One of two Pressure-Fired B&W Boilers installed at Astoria. This dry-bottom, Radiant Reheat Type unit incorporating B&W Divided-Furnace construction, has a design pressure of 2050 psi. Superheater outlet pressure and temperature are 1850 psi and 1000 F, with reheat to 1000 F. Designed steam output ranges between 1,200,000 and 1,370,000 lb per hr, depending upon type of fuel.

Astoria Generating Station of Consolidated Edison Co. which will ultimately have a generating capacity of about 1,000,000 kw.

# Goes on the Line

New from foundations to stacks, Astoria Station of the Consolidated Edison Co. of New York, Inc. represents a considerable advance in steam-electric power generating facilities. Significant features of this modern station include Pressure-Firing, one boiler-per-turbine, Cyclone Steam Separators for natural circulation, extra-fast starting of boiler and turbine, above-normal-capacity auxiliaries, and automatic shut-down protection.

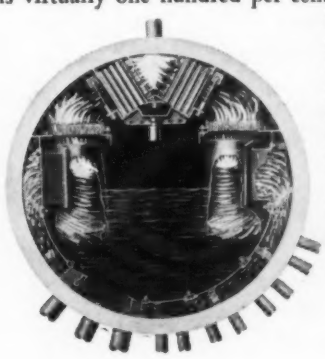
## *Pressure-Fired Boilers*

The two Pressure-Fired B&W Boilers are the largest units in the world without induced draft fans. Pressure-Firing was selected for this station on the basis of service-proved economies and advantages. These include:

1. Greater efficiency due to elimination of air infiltration with consequently lower stack loss.
2. Elimination of cost of induced draft fans with attendant controls, foundations, and ducts.
3. Savings in installed kilowatts for auxiliaries.
4. Savings in operating power needed for fans.
5. Reduced maintenance due to elimination of induced draft fans.
6. Smoother operation, simpler controls, and easier starting with only forced draft fans.

## *Natural Circulation with Cyclone Steam Separators*

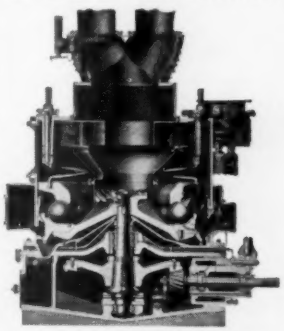
B&W Cyclone Steam Separators in the steam drum do a two-fold job. Separation of circulating water from steam is virtually one hundred per cent, thus assuring a high circulating head at all times. In addition, the Cyclones, in conjunction with steam scrubbers, help maintain turbine efficiency and reduce turbine maintenance by delivering steam of extremely high purity.



## *Building Saving with Divided-Furnace Construction*

The simple B&W Divided-Furnace construction makes it feasible to achieve the required furnace cooling surface without an excessive increase in building volume. Substantial savings in steel work and other structural components are made possible.

## *Type EL Pulverizers and Multi-Fuel Burners*



Each unit is served by five B&W Type EL Pulverizers which utilize the ball bearing principle of grinding. There are 22 circular burners suitable for use with oil, gas, or coal on each unit. Low maintenance is an outstanding feature of the EL Pulverizer which has long-life grinding elements made of a special abrasion-resistant material. Designed for ease of operation and simplified control, this design of pulverizer satisfies every requirement for economical, efficient direct-firing of pulverized coal.

* * * * * * * * * * * * *

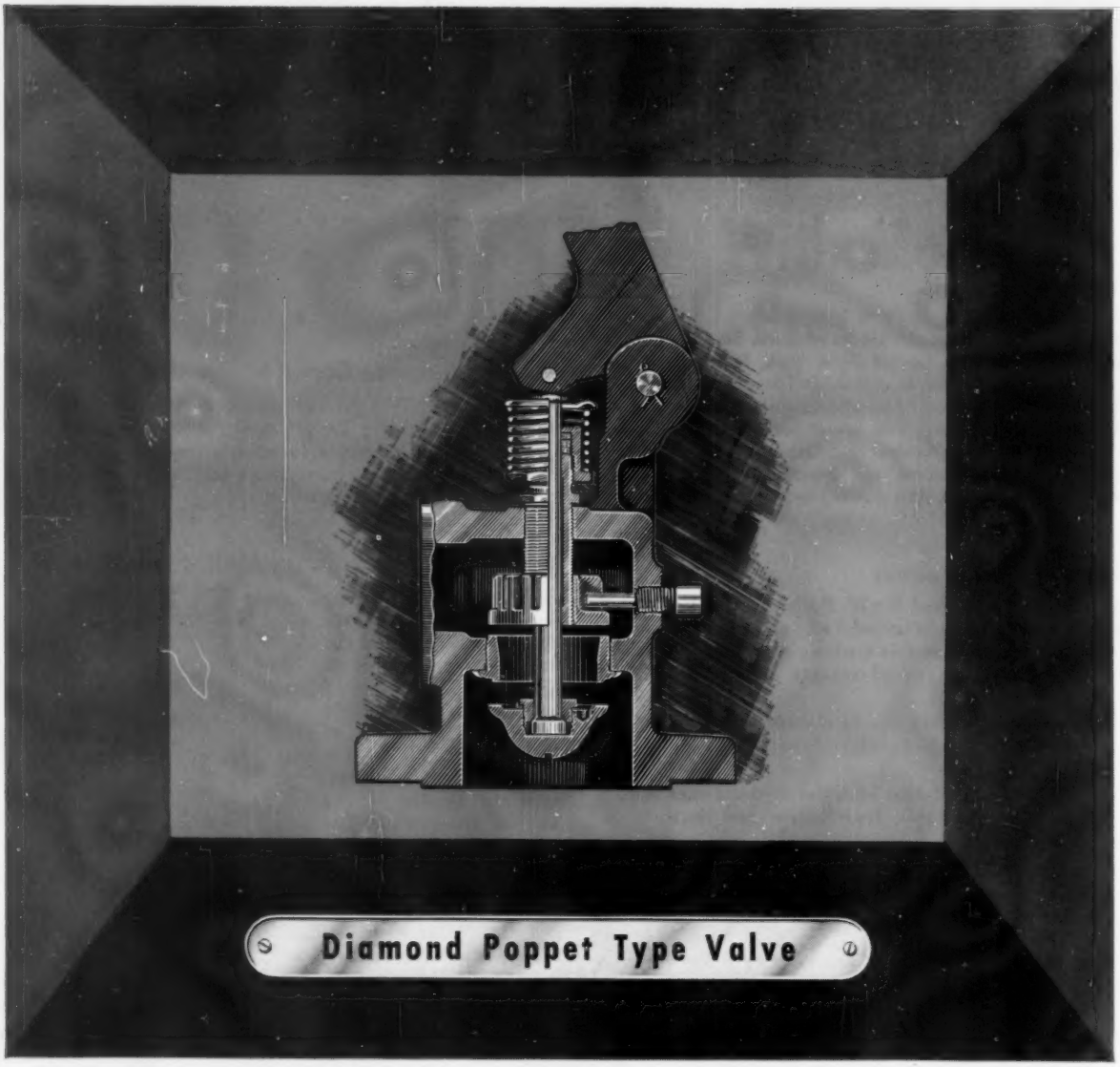
These and many other B&W engineering advances developed to increase the efficiency of steam generation are providing satisfactory and economical central-station and industrial service in plants across the country.

We will be glad to discuss them in terms of your future plans for boiler replacements or additional plant. For a detailed description of the features incorporated in Consolidated Edison's new Astoria Station, write for Bulletin 3-560. The Babcock & Wilcox Company, Boiler Division, 161 East 42nd Street, New York 17, N. Y.

BABCOCK & WILCOX

BOILER DIVISION

G-620




# An Engineering Masterpiece

More than 300,000 Diamond Poppet Type Valves control the flow to Diamond Models G9B, IR and IK Blowers. Long experience has proved this design most satisfactory for such severe service. Diamond construction assures tight seating every time without close adjustments. Valve seat is welded in for high pressures, and Stellited seating surfaces are available. Integral adjustable pressure control (located outside the path of valve travel) does not interfere with full and immediate opening of the valve, thus avoiding wire drawing. Micrometer-like adjustment permits very close regulation at low flow rates. Throttling at the back seat eliminates this damaging action on the main seat. No line orifice is required. Mechanical action is direct without pilot or diaphragm actuation. Rugged stem, proper guiding and small packing surface result in minimum maintenance.

This engineering masterpiece is one of the important reasons for the superiority of Diamond Blowers.

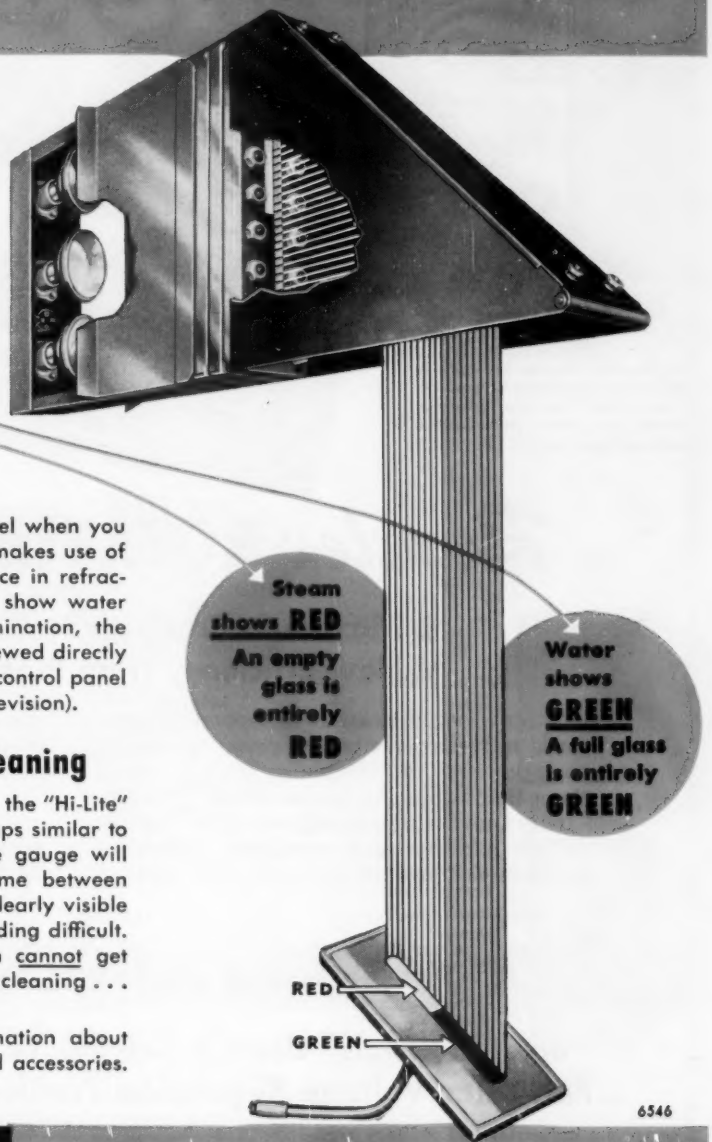
6654

**DIAMOND POWER SPECIALTY CORP.**
LANCASTER, OHIO
*Diamond Specialty Limited, Windsor, Ontario*

# DIAMOND BI-COLOR WATER GAUGE

## WITH "HI-LITE" Illuminator

*"You're Always SURE with Bi-Color"*




There is no guessing about boiler water level when you use the Diamond Bi-Color Water Gauge. It makes use of an unvarying optical principle (the difference in refraction between water and steam) to always show water green . . . steam red. With proper illumination, the water level is unmistakable . . . whether viewed directly . . . through a system of mirrors . . . or on control panel by use of Diamond "Utiliscope" (Wired Television).

### MORE Visibility with LESS Cleaning

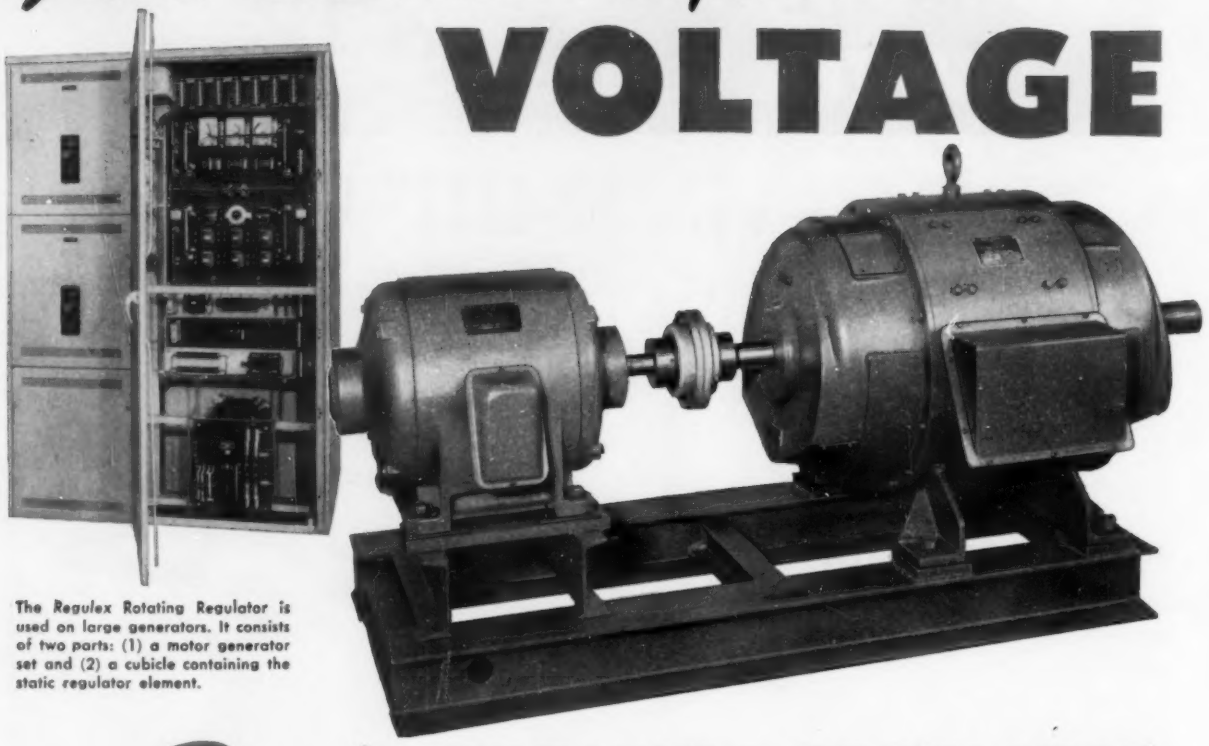
A big improvement over other light sources, the "Hi-Lite" Illuminator uses standard high-intensity lamps similar to automobile "sealed beam" headlights. The gauge will thus retain visibility with much longer time between gauge cleaning . . . it remains easily and clearly visible when dirty mica would otherwise make reading difficult. The lamps have sealed-in reflectors which cannot get dirty. The lamp faces are easily reached for cleaning . . . as are all other parts of the illuminator.

Bulletin No. 1051U gives interesting information about Diamond water gauges, water columns and accessories. Write for a copy.

50th ANNIVERSARY 1903-1953

**DIAMOND POWER SPECIALTY CORP.**
LANCASTER, OHIO
*Diamond Specialty Limited — Windsor, Ontario*

# *Fast, accurate, dependable* VOLTAGE



The *Regulex* Rotating Regulator is used on large generators. It consists of two parts: (1) a motor generator set and (2) a cubicle containing the static regulator element.

## *Regulex* ROTATING REGULATOR

★Maximum Productivity from New Generators
★New Efficiency from Present Installations

*Regulex* voltage regulators incorporating automatic minimum excitation permit generator operation close to the stability limit . . . much closer than manual operation allows. The sensitivity and exceptional response of the *Regulex* voltage regulator and associated equipment establish and maintain a safe ratio between generator load and field current . . . increase operating limits at any given power factor load . . . assure the proper reactive kva division. The *Regulex* voltage regulator does not require multiple special fields in the exciter — may be applied to any standard shunt machine. Write for literature. A-4189

## *New* Magnetic and Electronic Amplifiers

### Versatile "Tools" Used in Solving Your Particular Voltage Regulation Problem

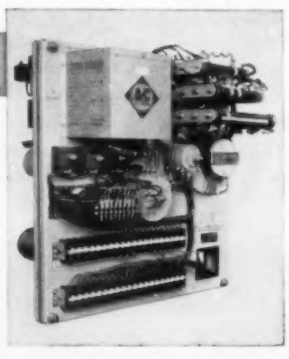
For special industrial and military regulating systems, added flexibility is obtained by using magnetic and electronic amplifiers. These components *supplement* but do not replace the *Regulex* rotating amplifier in most applications.

The magnetic amplifier is used primarily where reversible output from the amplifier is not required. Special exciter design is eliminated in such applications.

The shock-proof characteristics of the magnetic amplifier make it particularly adaptable to military voltage control.

Electronic amplifiers are used only on applications that require exceptionally high sensitivity.

Applications of magnetic and electronic amplifiers for purposes other than voltage control include speed, current, and tension regulation.



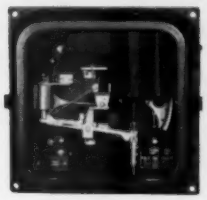
Voltage regulator with current limiting device. Used for control of static rectified dc power supply.

# REGULATION
## *For* ANY *Size Generator*

## *Rocking Contact* VOLTAGE REGULATORS

### *dc Applications*

The Type VD Regulator has been designed to meet the demands of voltage or current characteristics of dc machine operation. Resistors are cut in and out of the exciter shunt field by the *Rocking Contact* sector. No sluggish, time wasting relays. No vibrating or sliding contacts to wear out. A small movement of the *Rocking Contact* sector over a curved commutator covers the entire regulating range. Type VD regulators are available for all dc generators. Write for Bulletin 14B6137A.



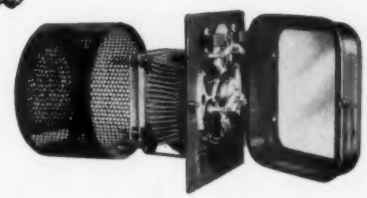
VD-2 Regulator for dc generators from 10 kw at 80 rpm to 200 kw at 3600 rpm

### *ac Applications*

Types V-00 and 221 Regulators

#### FOR SMALL GENERATORS

*Rocking Contact* Voltage Regulators are available in two types for use on small ac generators with direct-connected exciters — Type V-00 for generators to 157 kva maximum at 3600 rpm; Type 221 for generators to 438 kva maximum at 3600 rpm. These regulators can be modified for temperature compensation, shock mounting or other special requirements. Bulletin 14B6143A gives details.



Types A, B, & C Regulators

#### FOR MEDIUM SIZE GENERATORS

Types A, B, and C Regulators differ only in kva range.

**Type A Regulator**— for ac generators, 125 kva at 257 rpm to 1750 kva at 3600 rpm.

**Type B Regulator**— for ac generators, 1000 kva at 257 rpm to 6250 kva at 3600 rpm.

**Type C Regulator**— for ac generators from 3125 kva at 257 rpm to 25,000 kva at 3600 rpm.

All have guaranteed sensitivity of plus or minus 0.5%. Write for Bulletin 14B6035B.

#### FOR LARGE GENERATORS

Type J *Rocking Contact* Regulators are of the exciter field rheostatic type designed for the control of large synchronous machines. This regulator consists of two parts: (1) a voltage sensitive torque motor control element for panel mounting; (2) a motor-operated exciter rheostat with high speed field forcing contactors. Write for Bulletin 14B6015A.

Type J Element

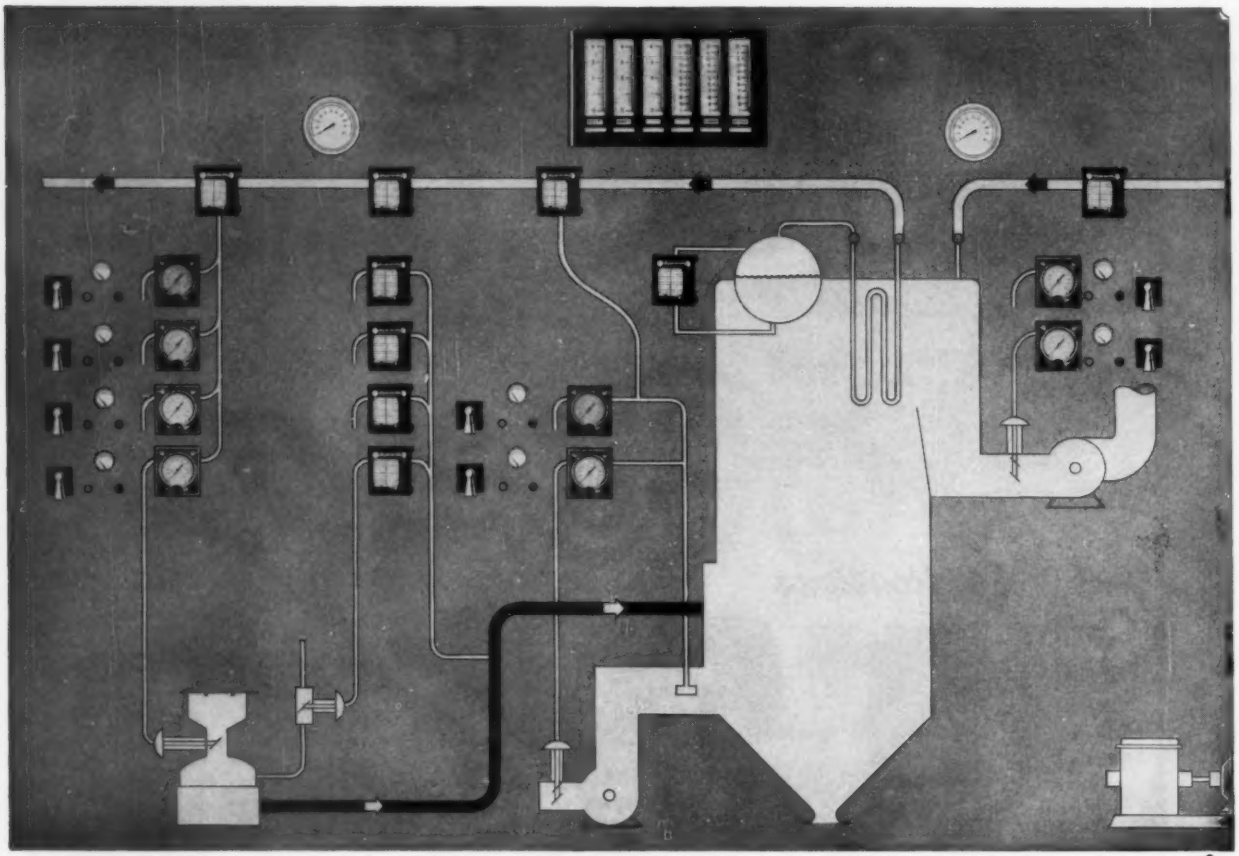
Motor-Operated Rheostat

*Regulex and Rocking Contact are Allis-Chalmers trademarks.*

# ALLIS-CHALMERS

**Milwaukee 1, Wisconsin**

# TO REDUCE



## COPES-VULCAN OFFERS ALL THESE CONTROLS

**COMBUSTION**

Combustion may be controlled from steam flow-air flow, or by fuel-air-ratio method. Instrumentation of the most modern design by Taylor assures fast response, accurate control and utmost dependability.

**FEED WATER**

Boiler Feed Water may be controlled from three, two or one influences. Feed water control systems may have *instrumentation by Taylor* (Type 3-L, Bulletin 1013), or be electrically or mechanically operated.

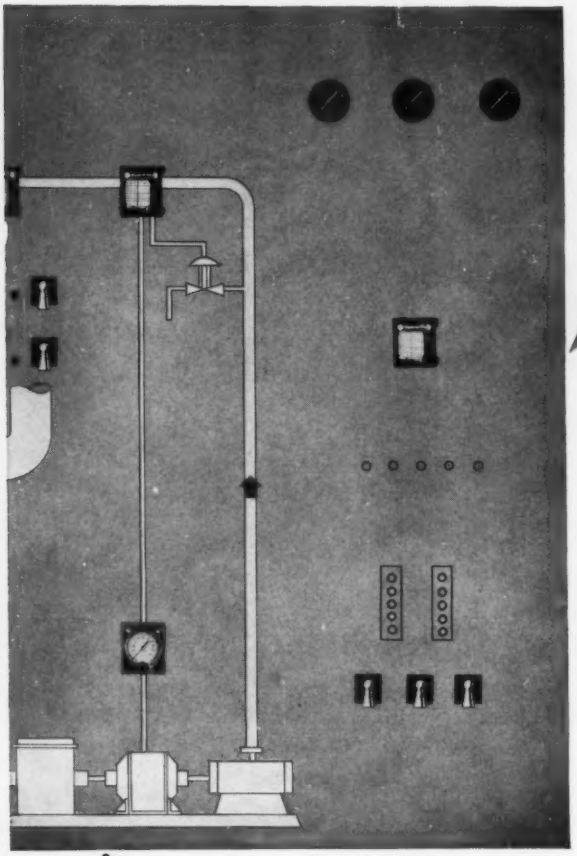
**PRESSURE AND TEMPERATURE CONTROL**

Pressure reducing valves to meet any need. Steam temperature control may be from three or two influences, using burner or damper positioning, gas recirculation, direct water spray or heat exchanger.

**SOOT BLOWING**

Full automatic-sequential control may be part of main panel or set up on separate panel. Individual push button control available. For smaller boilers there are manually operated units in several types.

# STEAM COSTS



## *Modernize With *C·V+T Boiler Control

WHEN you plan to modernize your power facilities, check into the many advantages offered by Copes-Vulcan Boiler Control.

From one dependable source, you can get modern combustion control *with instrumentation by Taylor*, precise feed water control, accurate steam temperature control and automatic cleaning of heat-transfer surfaces.

Remember, too, Copes-Vulcan assumes full responsibility for service wherever needed—for the life of your installation.

Ask Copes-Vulcan engineers for recommendations on how to reduce your steam costs. Write for Bulletin 1007-A.

*C·V+T=BBC

COPES·VULCAN+*Taylor*=BETTER BOILER CONTROL

**COPES-VULCAN DIVISION**

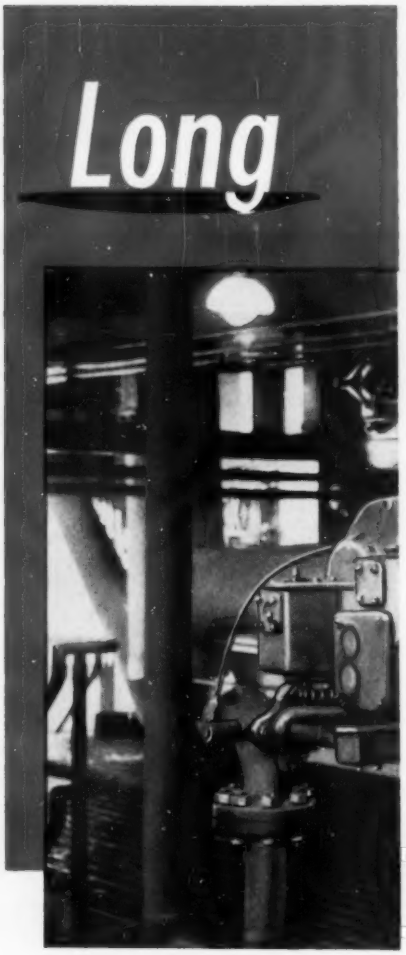
CONTINENTAL FOUNDRY & MACHINE COMPANY

**ERIE 4, PENNSYLVANIA**

COPES VULCAN BOILER CONTROL

**WITH INSTRUMENTATION BY *Taylor***

# VULCAN *because of...*




## DUAL MOTOR DRIVE

**Vulcan uses two motors. One extends and retracts the lance. The other rotates it. Motors may be air or electric. Speeds are independently adjustable.**

## JET AND LANCE DESIGN

**Vulcan offers jets tailored to the job—straight bore or venturi; and angled to reach specific surfaces. Jets normally rotate while traversing, but may traverse only or oscillate through any angle. Lances from opposite sides of the furnace may fail to "meet" by as much as 12 feet, yet clean thoroughly.**

## CHOICE OF BLOWING MEDIUM

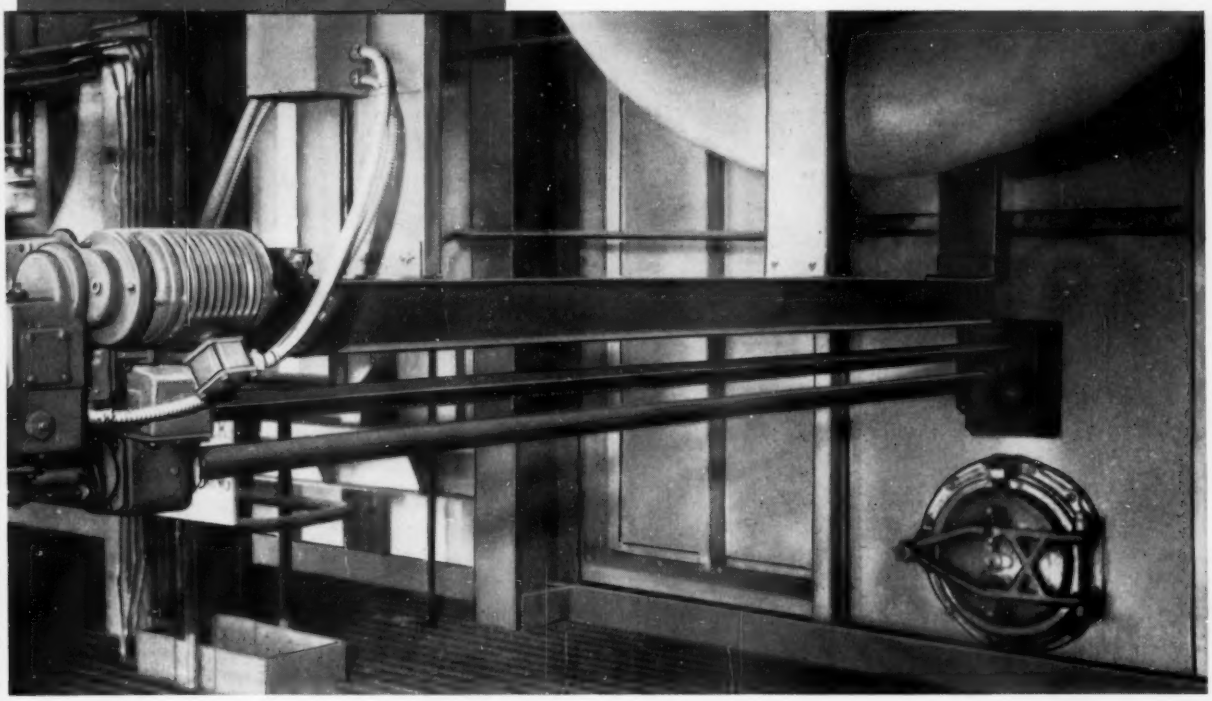
**You can blow with any medium—air, steam or water, or any combination of them—*without change of equipment.***

## CHANGE OF PACE

**Two motors allow stop-and-go indexing with uniform rotation—or fast-and-slow change of pace. On "stop and go," the lance is stopped and rotated to clean the tubes—then sped across the open areas to the next row of tubes. On "fast and slow," the lance is slowed to clean the tubes, and sped while passing open areas. In each case, the result is a saving of blowing medium.**

# VULCAN *Automatic*

# Retracts clean better



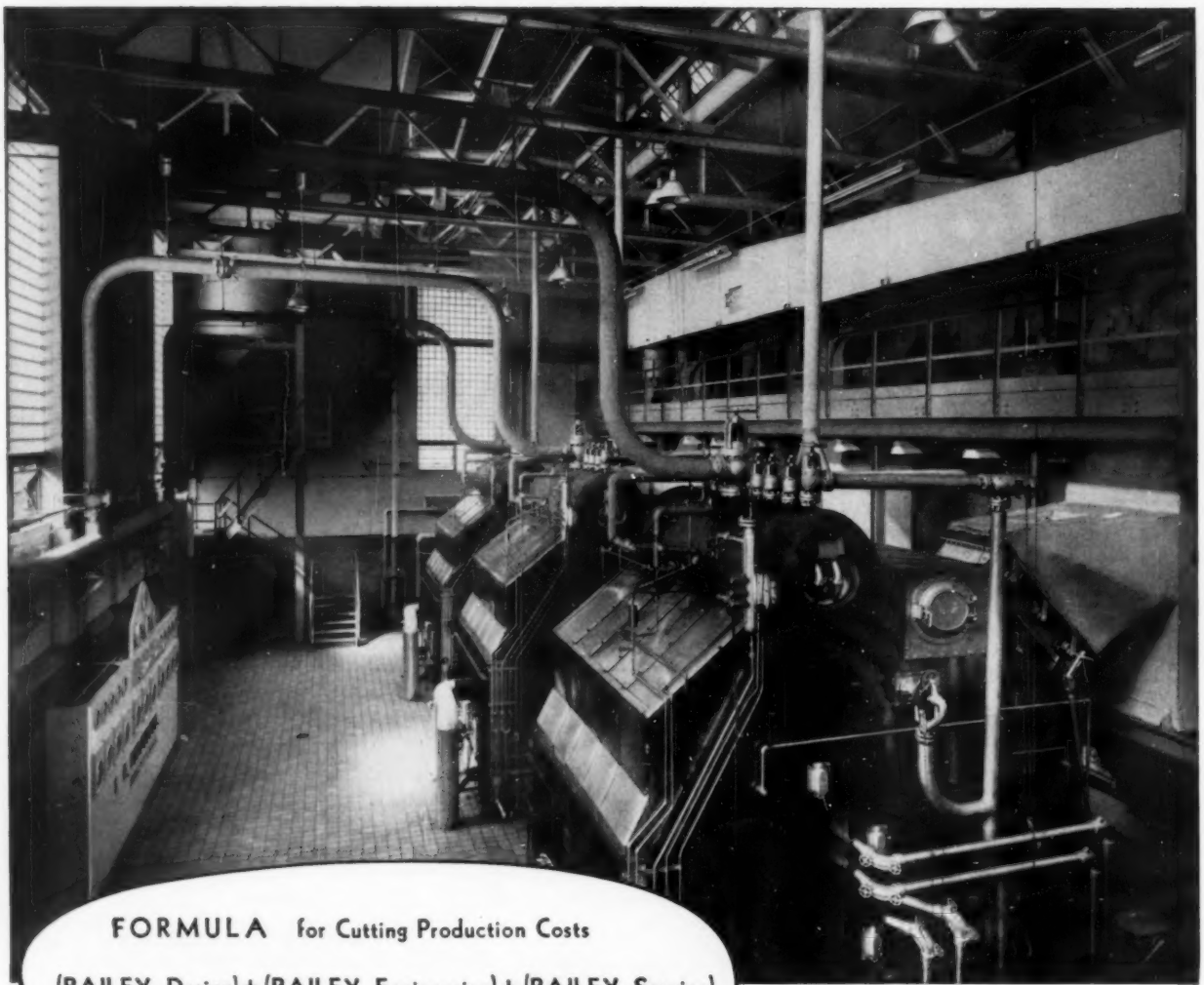
Vulcan Long Retracts clean better—with fewer outages, at lowest cost. They are engineered for optimum performance under varying conditions. They work equally well at any angle. They give you the benefit of dual-motor operation—one motor to traverse the lance, a second to rotate it. *Rotation is always in the same direction.* Repeated cleaning cycles result in an infinite number of double-helix paths that continually broaden the cleaning coverage. Lances can pass through as little as four inches of tube clearance. Write for Bulletin 1002.

**COPES-VULCAN DIVISION**

CONTINENTAL FOUNDRY & MACHINE COMPANY

**ERIE 4, PENNSYLVANIA**

# How to



FORMULA for Cutting Production Costs

(BAILEY Design) + (BAILEY Engineering) + (BAILEY Service)

= GREATER SAVINGS PER FUEL DOLLAR

In the Nela Park central heating plant of General Electric Company, Bailey Meter Control insures efficient use of fuel. It enables operators to run these 18,000 lb per hour 125 psi spreader stoker-fired boilers under optimum conditions at all times.

# Save Fuel

★ The productive energy produced by a unit of fuel depends on the way you put it to work in your boiler. How much heat energy you actually get depends upon the performance of your steam plant equipment.

That's where Bailey Controls can help. With a Bailey-engineered control system, you can count on a higher output of available energy per unit of fuel. Here's why:

**1. Complete Range of Equipment—fully co-ordinated**

You need never worry that a Bailey Engineer's recommendation is slanted in favor of a particular type of equipment, as might be the case if he had only a limited line to sell—or that Bailey will pass the buck for efficient control; we offer *complete* boiler control *systems*.

**2. Engineering Service—backed by experience**

No other manufacturer of instruments and controls can offer as broad an experience based on succesful installations involving all types of combustion, flow measurement, and automatic control.

**3. Direct Sales-Service—conveniently located near you**

Bailey Meter Company's sales-service engineers are located in more industrial centers than those of any other manufacturer of boiler control systems; you get prompt, experienced service with a minimum travel-time and expense.

For greater fuel savings, less outage, and safer working conditions you owe it to yourself to investigate Bailey Controls. Ask a Bailey Engineer to arrange a visit to a nearby Bailey installation. We're proud to stand on our record.

A-117-2

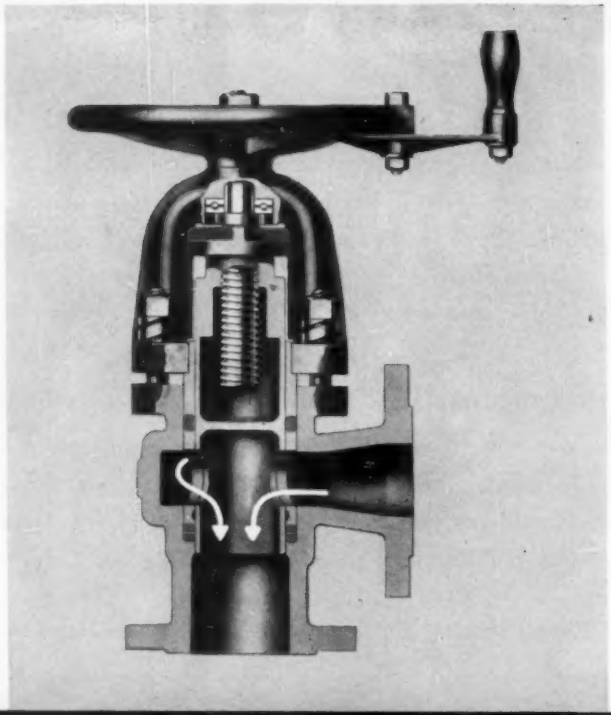
BAILEY
METER COMPANY
1036 IVANHOE ROAD
CLEVELAND 10, OHIO
*Complete Controls for Steam Plants*

BAILEY METERS
*Controls for*
COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS

# These YARWAY VALVE DESIGNS

## YARWAY SEATLESS

Features balanced nitralloy hollow plunger that seals line drop-tight, yet permits free, unobstructed flow in blow-down. Other features —laminated packing, alemite lubrication, ball thrust bearings. USED SUCCESSFULLY IN OVER 15,000 BOILER PLANTS.



FOR LOW and MEDIUM PRESSURES

## YARWAY HARD-SEAT

Features tough, stellite-faced and ground disc and seat ring, mated to provide smooth long-wearing surfaces. Stream-line flow. Alemite lubrication. MORE THAN 4 OUT OF 5 HIGH PRESSURE BOILER PLANTS USE YARWAY BLOW-OFF VALVES.

FOR HIGHER PRESSURES

**USED IN OVER 15,000 BOILER PLANTS**

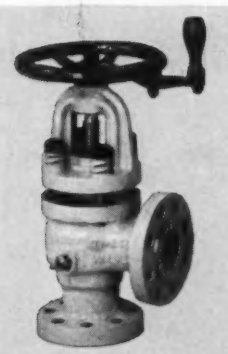
# serve every boiler blow-down need

■ Whatever your *pressure* requirement, whatever your *piping* requirement—there's a Yarway Blow-Off Valve to exactly meet your needs.

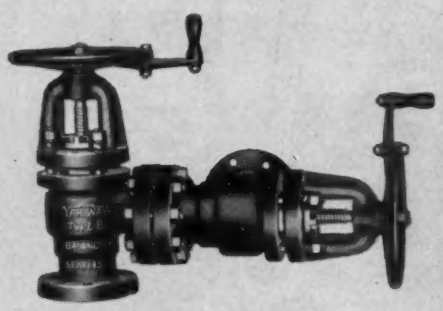
Popular Yarway *seatless* design keeps blow-down lines drop-tight in low and medium pressure ranges. Sturdy Yarway *stellite seat and disc* design protects higher pressures.

All Yarway Blow-Off Valves are strong, rugged valves, built to withstand the punishment of regular or emergency blowing-down under full boiler pressure, and are available in metals that stand up under acid washing of boilers.

Write for new Yarway Blow-Off Valve Bulletins—B-426 (pressures to 400 psi) or B-434 (pressures to 2500 psi).



• Yarway Type B Seatless Blow-Off Valve, iron body for boiler pressures to 200 psi, steel bodies, for pressures to 400 psi. Angle valve shown, straightway available. Flanged connections. See Bulletin B-426.

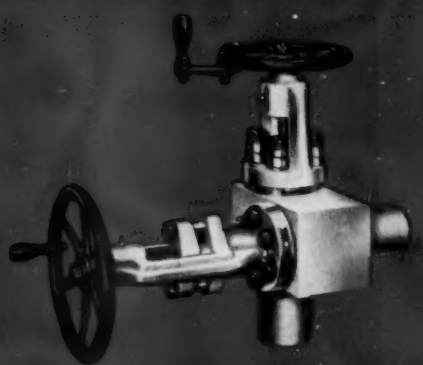


• Yarway Type B Seatless Tandem Blow-Off Valve combining two angle valves. Other combinations available. Iron bodies for boiler pressures to 200 psi, steel bodies for pressures to 400 psi. See Bulletin B-426.

• Yarway Type C Seatless Tandem Blow-Off Valve combining angle and straightway valves. Other combinations available. Flanged or welding connections available. For boiler pressures to 600 psi. NOTE: When used in tandem with a Yarway Hard-Seat Valve, Type C Seatless may be used to 1500 psi. See Bulletin B-434.

• Yarway Hard-Seat Blow-Off Valve for pressures to 2500 psi. Straightway valve shown. Angle available. Welded (shown) or flanged connections. See Bulletin B-434.

• Yarway Hard-Seat—Seatless Bolted Tandem Blow-Off Valve. Hard-Seat is the blowing valve, seatless is the sealing valve. Available in any combination of connections. For pressures to 1500 psi. Hard seat-hard seat tandems for pressures to 2500 psi. See Bulletin B-434.



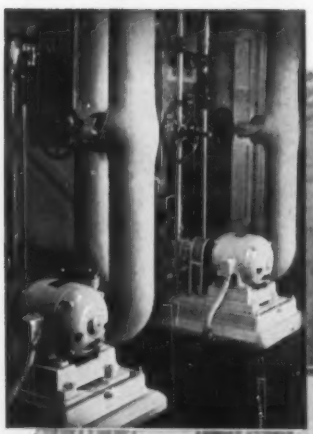
• Yarway Unit Tandem Blow-Off Valve. Combines a hard-seat blowing valve and a seatless sealing valve in one-piece forged steel body for boiler pressures to 1500 psi. For pressures to 2500 psi, two hard-seat valves are combined. See Bulletin B-434.

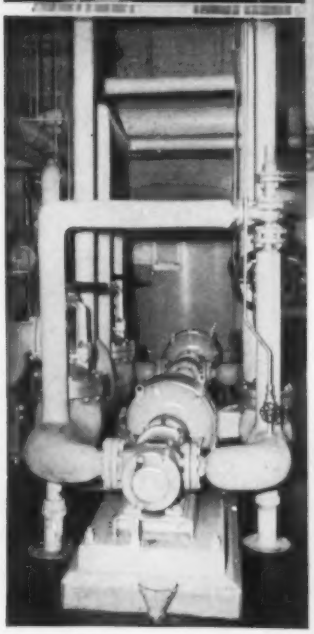
*LET YARWAY HELP SOLVE YOUR BOILER BLOW-DOWN PROBLEMS!*

**YARNALL-WARING COMPANY**
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY — **blow-off valves**

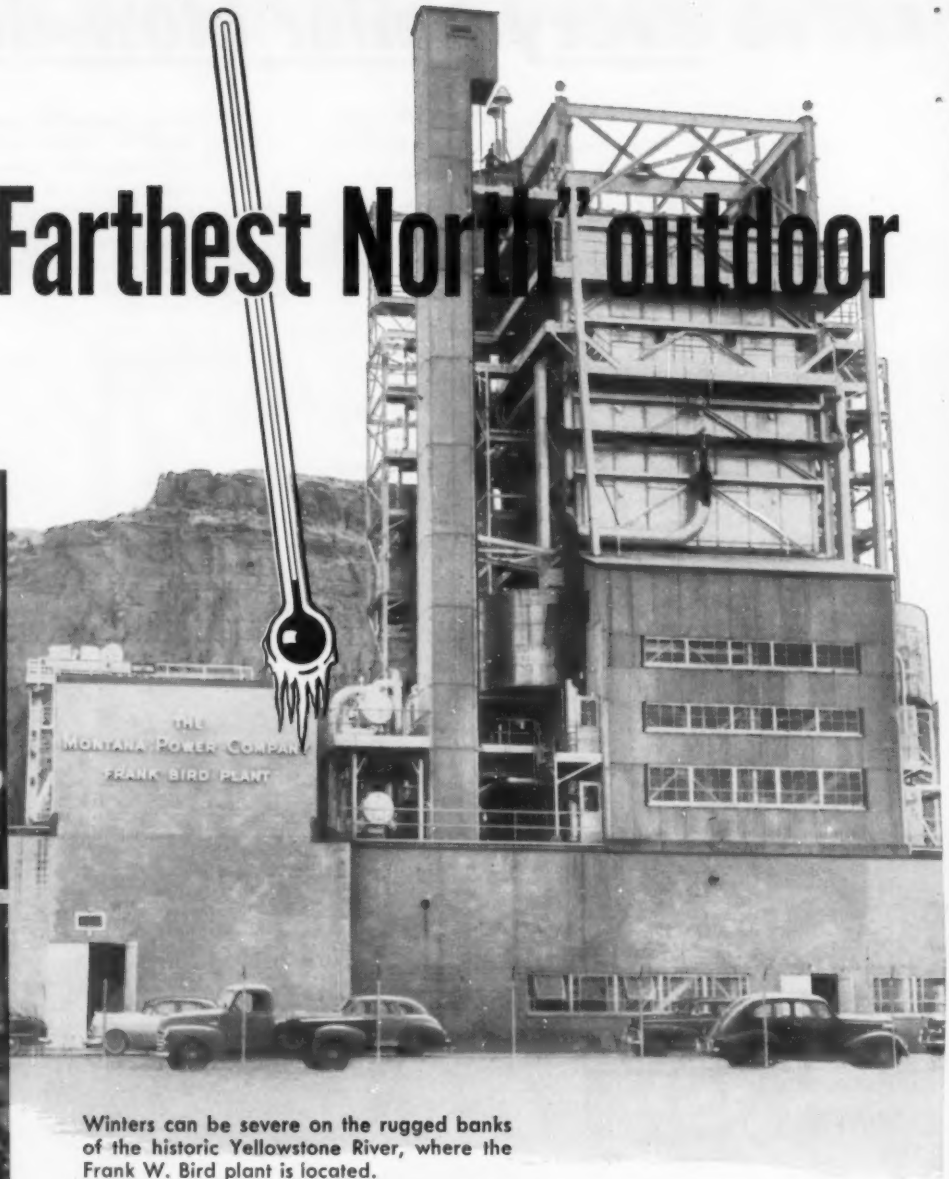
# In this "Farthest North" outdoor





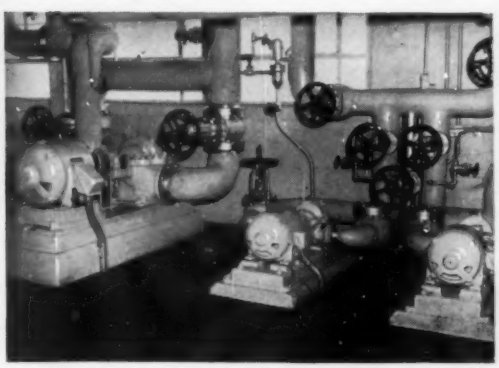
Some of the many Elliott C-W motors on pumps for oil burners, fuel oil transfer, condensate transfer, etc., as well as a number of other auxiliaries.

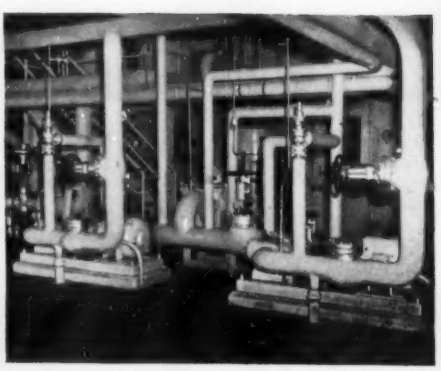
Q3-6




Winters can be severe on the rugged banks of the historic Yellowstone River, where the Frank W. Bird plant is located.

The station was designed and constructed by Ebasco Services, Incorporated.





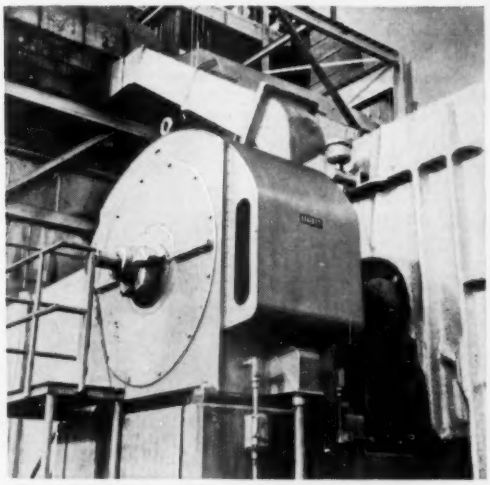
# type station...

# ELLIOTT MOTORS

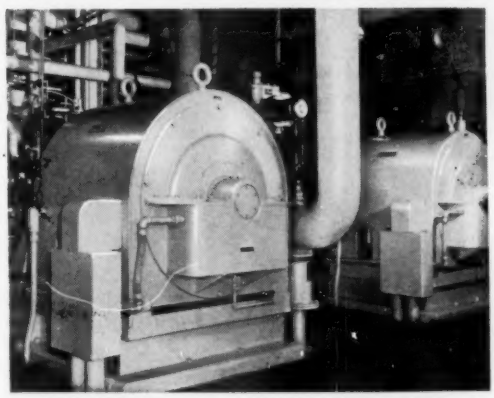
FORTY BELOW is not an uncommon winter temperature at the Frank W. Bird Steam-electric Station of the Montana Power Company, near Billings. Blizzard conditions too, naturally. Pretty tough sleddin' for exposed equipment, but not too tough for the Elliott 1000-hp motor driving the induced draft fan in the picture at the right. This is the increasingly popular outdoor splashproof (weather-protected) design that needs no ducts nor cored foundation. A similar motor of vertical type, 500-hp, drives a circulating water pump located on the exposed river bank. Other large Elliott motors serve the plant in less exposed locations, as well as a number of Elliott Crocker-Wheeler motors of open dripproof type on auxiliaries —quiet, capable performers, all doing their share in holding station costs down.

Your local Elliott representative or district office will give you complete data on the Elliott motors mentioned, or any other types you may need. Or write Elliott Company, Jeannette, Pa.

Out on the open river bank, buffeted by bitter winds, snow, sleet, etc., this Elliott 500-hp 12-pole vertical outdoor splashproof (weather-protected) motor drives a circulating water pump.



This Elliott 1000-hp outdoor splashproof (weather-protected) motor drives an induced-draft fan.



Two 1250-hp two-pole squirrel-cage induction motors on boiler-feed pump service.

**ELLIOTT Company**

STEAM TURBINES • MOTORS • GENERATORS • DEAERATING HEATERS • EJECTORS • CONDENSERS • CENTRIFUGAL BLOWERS • TURBOCHARGERS • TUBE CLEANERS • STRAINERS

***CROCKER-WHEELER DIVISION • RIDGWAY DIVISION***

**BUILT FOR TODAY AND TOMORROW** Located in the heart of a growing industrial and residential area, this central station has installed an "expandable" S-A conveying system. A good example of how S-A engineering can plan for changing needs, it is designed for lowest cost coal handling now and for continued economical operation when expanded to handle three times the present 200 tons per hour. Handling costs will stay low at all volumes!

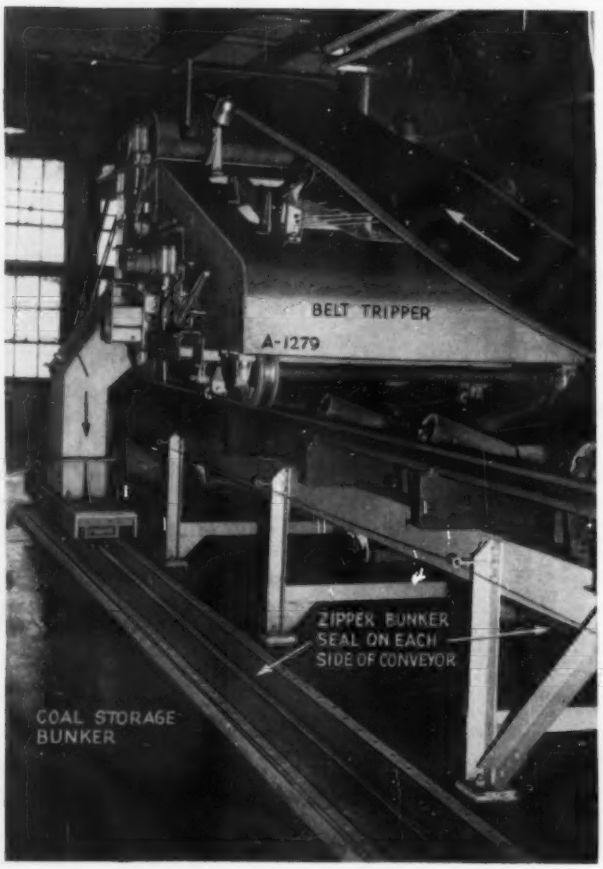
# Engineered Conveying Systems REDUCE COAL HANDLING COSTS

The Stephens-Adamson coal conveying systems shown here, while different in components, design and layout, have one characteristic in common. They were all engineered to individual plant needs —to insure coal handling at low cost per ton. This economy is reflected in lower steam costs.

"Tailoring" to particular requirements is comparatively simple for S-A engineers. They draw upon a complete line that includes every kind of equipment for handling coal. They are backed by over half a century of experience in solving literally hundreds of different coal handling problems.

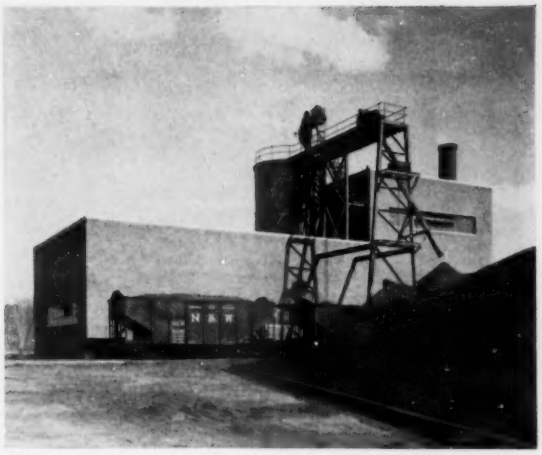
This combination of complete equipment, plus the detailed experience and "know-how", can be invaluable when improvement and modernization of your coal handling facilities is under consideration.

Write and we'll arrange a free survey—without obligation, of course.

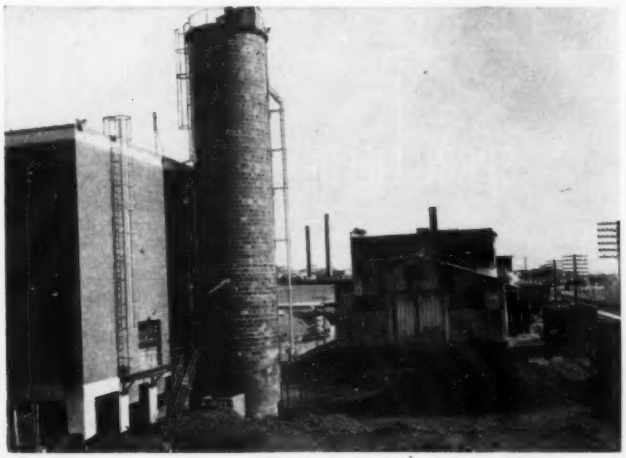



**COAL ZIPPED-IN** S-A patented Zipper bunker seal and belt tripper is part of new S-A coal handling system recently installed at a central station in Ohio. The seal consists of two strips of rubber with meshing teeth opened or closed by rollers mounted on the discharge spouts of tripper. Works like a slide fastener and keeps dust to a minimum inside the station.

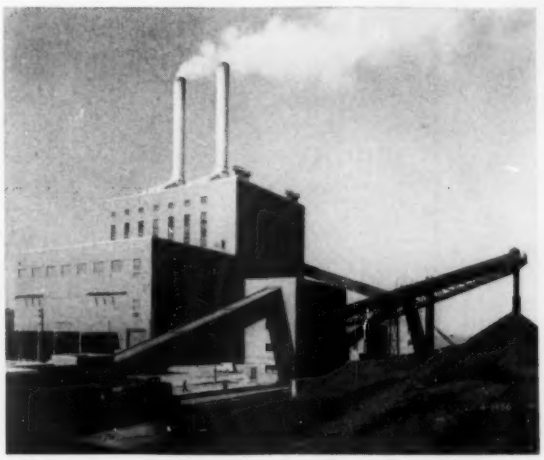
**LESS LABOR COST — AND NO DUST** Automatic, dustless coal handling made possible by S-A REDLER Conveyors is playing a major role in cutting weekly labor costs from $606 to $242 for this Maine textile mill. That amounts to a saving of $19,000 per year. REDLER units also have provided the layout flexibility required to meet difficult location problems existing in the plant.



**EFFICIENT HANDLING IN SMALL SPACE** This S-A REDLER conveying system at a municipal station in Virginia, moves 30 tons of coal per hour to either live storage above stokers or to outside stock pile. The system illustrates S-A design and use of REDLER units to save space, seal in coal dust and operate with minimum maintenance. From track side to stokers, S-A conveying systems can be engineered for any coal handling or distribution job.



**SAVES $90,000 A YEAR** Modernization of power plant with new boilers and controls and the installation of an engineered S-A conveying system for coal has enabled this North Carolina bleachery and finishing works to slash operating costs. Storage silo at left is filled by S-A REDLER Conveyor. Another REDLER carries coal to stoker hopper—without dust or high maintenance costs—while S-A Swivel piler stock piles overflow from silo.



**750 TONS PER HOUR** That's the capacity of the S-A belt conveying system at this Great Lakes station. Efficient arrangement of coal handling system which S-A engineers helped design permits coal stockpiling when bunkers in plant are full. Stocking-out conveyor at right is equipped with a motor controlled, telescoping spout. A similar plant operated by the same company is also S-A equipped.

SINCE 1901 S-A STEPHENS-ADAMSON MFG. CO.

## STEPHENS-ADAMSON MFG. CO.

5 Ridgeway Avenue, Aurora, Illinois • Los Angeles, Calif. • Belleville, Ontario

**Engineering Division**

Specialists in the design and manufacture of all types of bulk materials conveying systems.

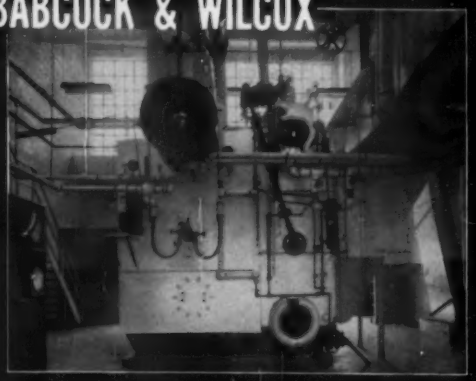
**Standard Products Division**

A complete line of conveyor accessories including centrifugal loaders—car pullers—bin level controls—etc.

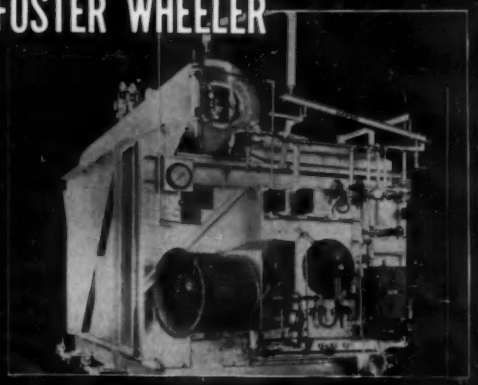
**SealMaster Division**

A complete line of industrial ball bearing units available in both standard and special housings.

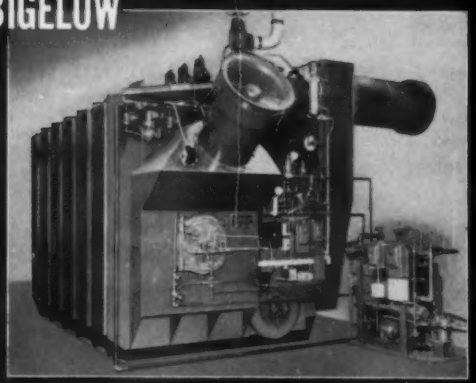
BABCOCK & WILCOX



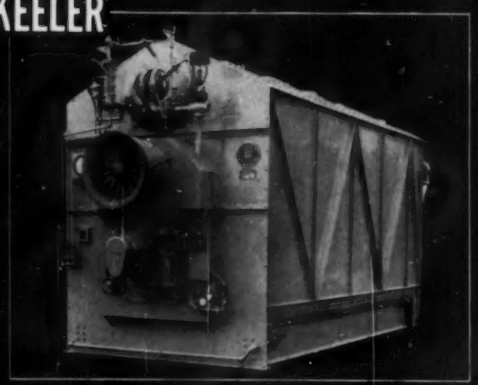
FOSTER WHEELER



BIGELOW

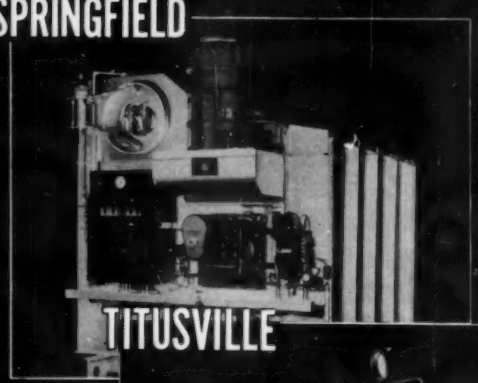


KEELER

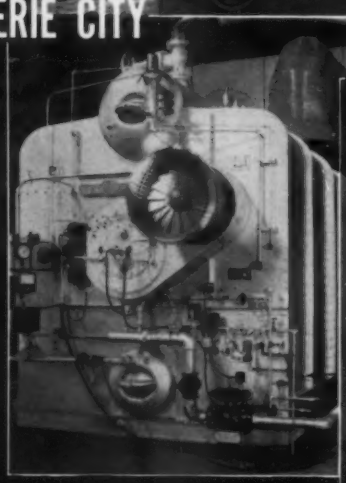


BROS

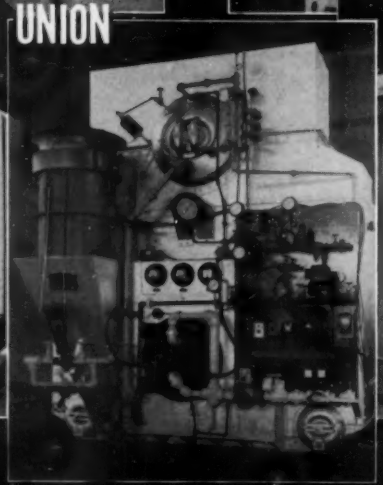
SPRINGFIELD



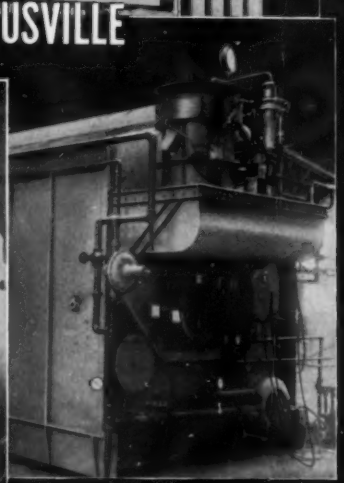
ERIE CITY



UNION



TITUSVILLE



# WHY DO ALL THESE LEADING BOILER MAKERS USE WING FORCED DRAFT FOR THEIR PACKAGED UNITS?

## HERE'S WHY:

1. Airfoil fan blading gives top efficiencies.
2. Wing Voltrol Vanes give 90% capacity control.
3. Pre-sealed bearings lubricated for their life.
4. Only 8 bolts required to mount blower on windbox.

**L. J. Wing Mfg. Co.** 50 Vreeland Mills Road, **Linden, N. J.**

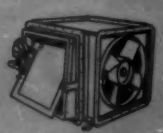
*Factories: Linden, N. J. and Montreal, Can.*

REVOLVING UNIT HEATERS

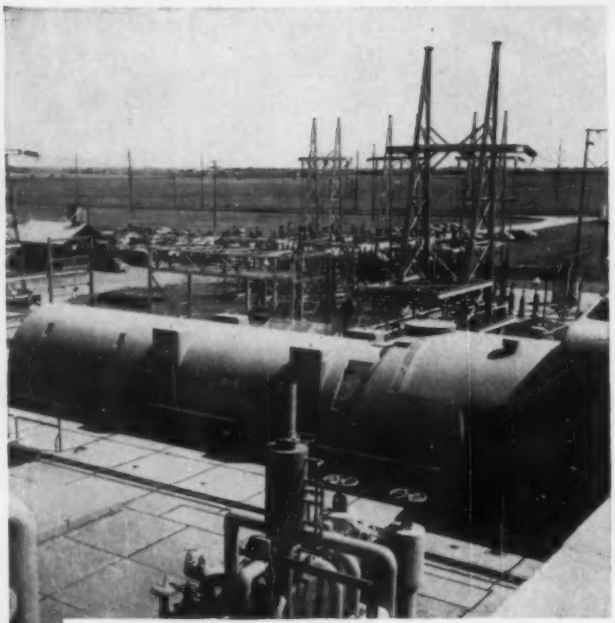
STRAIGHT LINE DUCT FANS

ELBOW TYPE DUCT FANS

AXIAL FLOW BLOWERS


FURNACE DRAFT INDUCERS

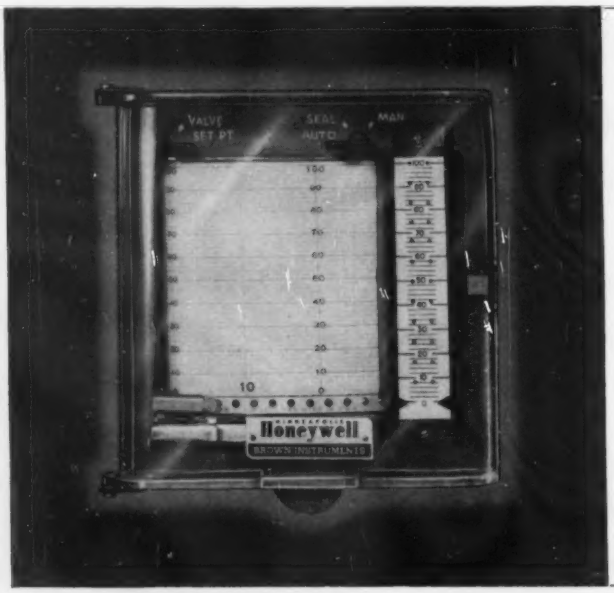
STEAM TURBINES



**FUNCTIONAL DESIGN** *is the keynote of the New Murray Gill Station designed by Ebasco for Kansas Gas & Electric Co. Above is an outdoor-mounted 47,000-kw generator unit.*

**ON THE BACK OF THE CONTROL PANEL** *are grouped full-size instruments such as these* **ElectroniK** *temperature recorders. But look on the operating side . . .*

# *Tel-O-Set recorders* on compact

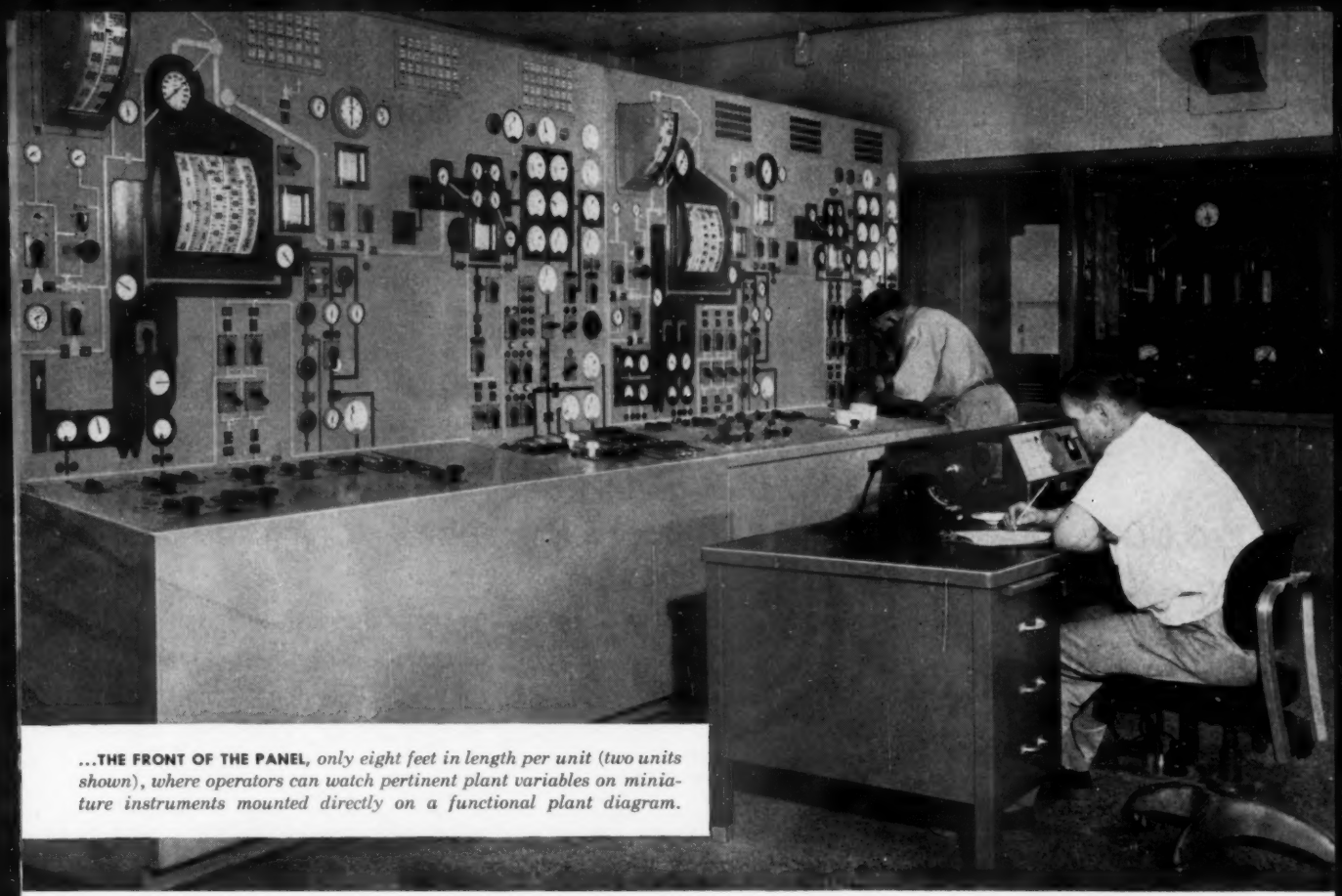



## *Every feature you need in a miniature recorder*

*Tel-O-Set* recorders are applicable to measurements of temperature, pressure, flow and liquid level. They embody a simple, rugged pneu natic receiving system that is actuated by low-pressure air from the remote transmitter.

The recording chart moves horizontally. A full 8-hour record is quickly available.

The panel cutout required is only five inches square. In the mounted position, the instrument can be withdrawn from its case for easy inspection and adjustment.



...**THE FRONT OF THE PANEL,** *only eight feet in length per unit (two units shown), where operators can watch pertinent plant variables on miniature instruments mounted directly on a functional plant diagram.*

# show critical trends graphic control panels

BOILER and turbine control panels, which used to stretch for dozens of feet along the sides of a central control room, are now being compressed into small, convenient size. The key to this new technique, pioneered by Ebasco in the power industry, is graphic instrumentation . . . which displays all vital operating variables on a plant diagram. Graphic panels bring complete plant operation into sharp focus . . . improve operator's efficiency . . . speed training of new men . . . and simplify start-up and emergency control.

For displaying the many variables which need more than instantaneous indication, *Tel-O-Set* miniature recorders are ideal on graphic panels. They take no more panel space than many dial indicators. And they provide a record which reveals trends, so that operators can know which way related variables are moving, and how fast.

When you're planning graphic instrumentation, plan to utilize *Tel-O-Set* recorders for these essential "trend indicators." Your nearby Honeywell sales engineer will be glad to discuss how they can be applied to your own control panels. Call him today . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Aves., Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for new Bulletin No. 9050, "Instrumentation for Steam Generation."

MINNEAPOLIS **Honeywell**

BROWN INSTRUMENTS

*First in Controls*

# Revolutionary Performance!

## Riley Boiler Unit gives bonus of 20,000 pounds per hour of steam to Masonite Corporation

Here's the maximum capacity guaranteed to Masonite by Riley Stoker Corporation:

50,000 lb. continuous
60,000 lb. for 15 min. peaks

And here's the Masonite report on performance: "For the past 75 days the average hourly load on the new boiler has been 70,000 pounds with peaks of one and more hours' duration of 75,000 pounds."

This same installation called for a guaranteed air heater gas temperature not in excess of 395 degrees at 50,000 pounds of steam per hour. In actual operation at 54,500 pounds of steam per hour, the air heater exit gas temperature was only 377.5 degrees!

No wonder Riley Stoker Corporation, Worcester, Massachusetts, is so well known among leading plants throughout the nation for the highly efficient performance of its boilers!

**Coppus-Dennis FANMIX Burners Were Installed**

To assure such revolutionary performance, Riley specified Coppus-Dennis FANMIX Burners for its boilers. The exclusive FANMIX action — on *all* Coppus burners, gas as well as combination gas-oil — is the reason for such performances.

**FANMIX : Better Combustion : Better Efficiency : Higher Ratings**

FANMIX burners, with their *revolving orifices*, give violent mechanical mixing and agitation of gas and air and, therefore, instantaneous and complete combustion with *minimum excess air* (5% excess air not unusual).

Furnace space is not required for mixing; therefore, *higher boiler ratings* are easily obtained.

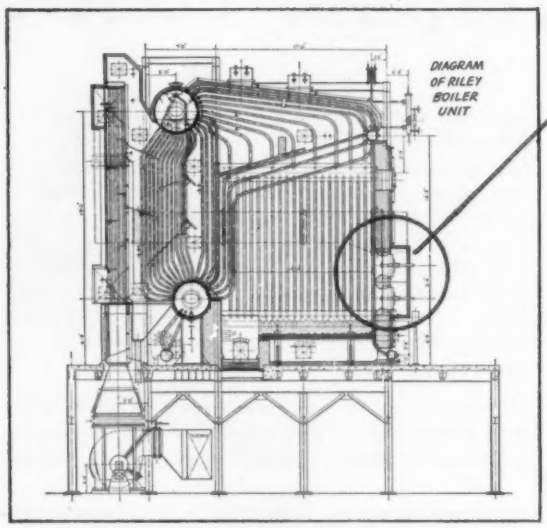
FANMIX burners, with shorter flame than any other burner, cannot cause flame impingement.

FANMIX burners, incorporating a *fan* as an integral unit, have *no draft loss* across the burner. Therefore, regardless of draft conditions, increased ratings are possible.

FANMIX action, with its quick completion of combustion, gives *lower* exit gas temperatures.

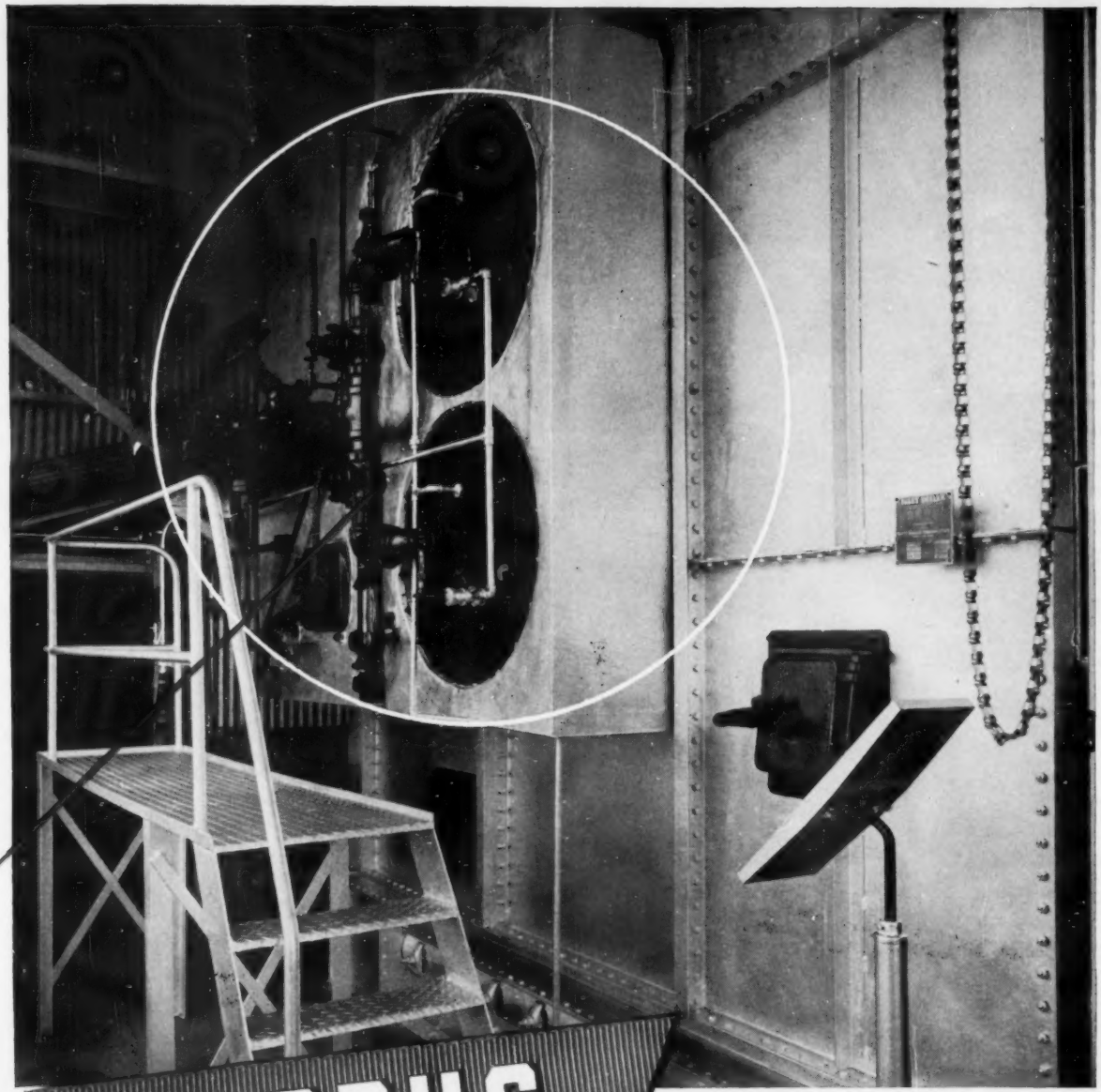
Plan now to take advantage of Coppus-Dennis FANMIX action with your present boiler. Remember — no forced draft equipment nor increase in stack nor increase in furnace volume is required for *FANMIX* operation to get increased capacity. And on *new* boilers, FANMIX lets you plan on reduced combustion space, higher ratings, less stack height or reduced induced draft capacity, and *no* forced draft equipment. Mail coupon today. Sales offices in *Thomas' Register*. Other "Blue Ribbon" Products in *Chemical Engineering Catalog, Refinery Catalog, Best's Safety Directory, and Mining Catalogs.*

**JET REACTION** is utilized to rotate fan which is integral part of burner. Automatically proportioned high velocity air passes at right angles through fuel to create ideal mixture for fast, complete combustion and peak efficiency.




**Well-Known Users of Riley Units with FANMIX Burners Include:**

Publicker Commercial Alcohol Co.
Monsanto Chemical Co.
Gaylord Container Corp.
Commercial Solvents Corp.
Celanese Corp. of America
Gulf Power Co.
Mississippi Power Co.
Eagle-Picher Lead Co.
Humble Oil & Refining Co.
Godchaux Sugars, Inc.
Kennecott Copper Corp.
Nicholson File Co.
Bird & Son, Inc.
— and many others




**RILEY BOILER UNIT,** using FANMIX burners, is here shown as installed for the Masonite Corporation, Laurel, Mississippi. Circle in diagram at left indicates position of burners pictured above.

**SEND COUPON** for further information. Coppus engineers FANMIX burners to your individual requirements.

**PLEASE ATTACH THIS COUPON TO YOUR COMPANY LETTERHEAD**

**COPPUS ENGINEERING CORPORATION**
162 Park Avenue
Worcester 2, Massachusetts

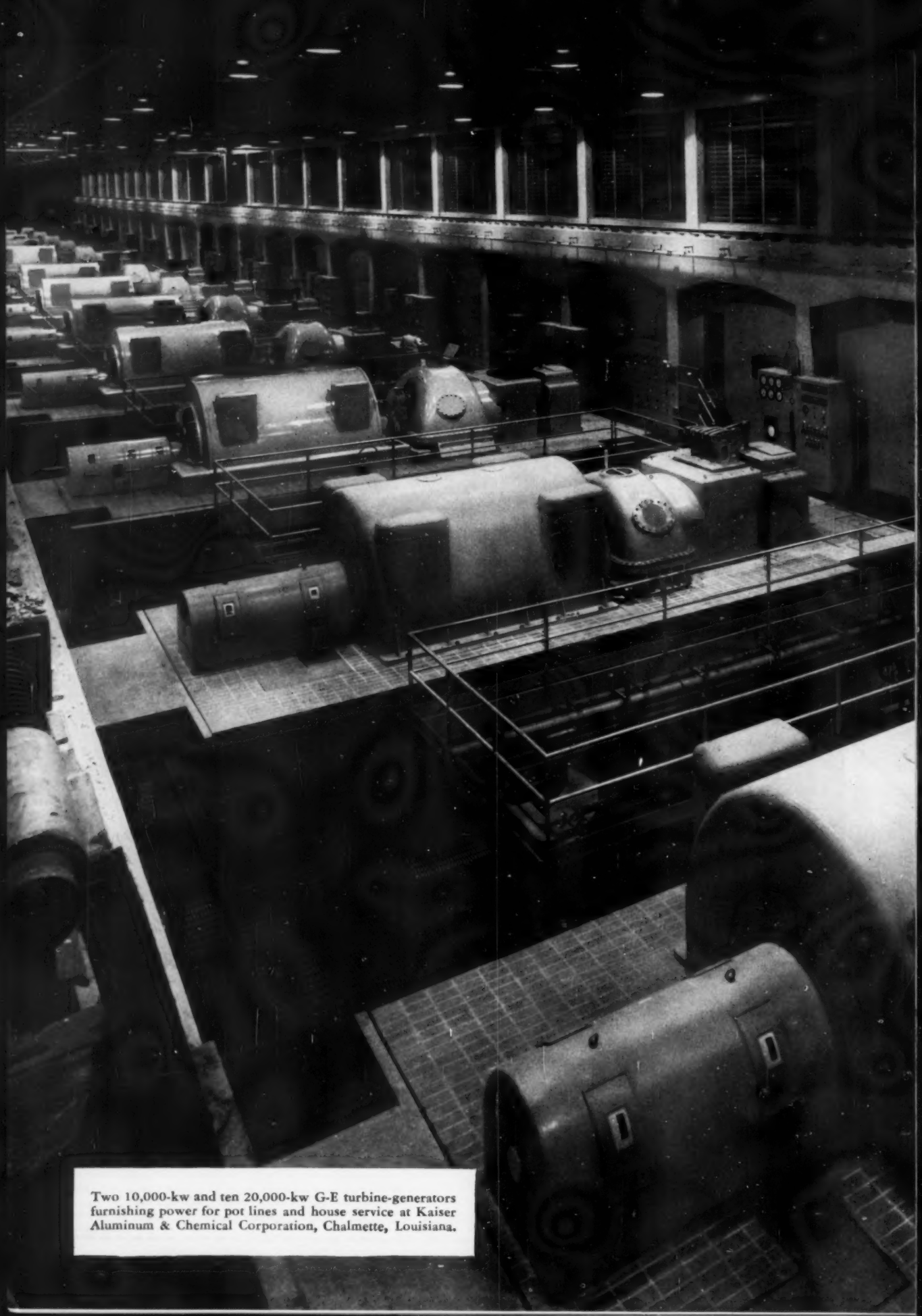
Please send complete data on Coppus-Dennis FANMIX Burners. I'm particularly interested in
☐ gas ☐ combination gas-oil.

Name..... Title.....

Company.....

Address.....

City..... Zone..... State.....



Two 10,000-kw and ten 20,000-kw G-E turbine-generators furnishing power for pot lines and house service at Kaiser Aluminum & Chemical Corporation, Chalmette, Louisiana.

G-E Service Engineer making final inspection of 20,000-kw G-E turbine-generator at Kaiser Aluminum & Chemical Corporation. Two 10,000-kw units in background furnish power for house service.

# Kaiser Aluminum Operates Sixteen G-E Turbines in Huge New Plant

## KAISER ENGINEERS SELECT G-E TURBINES FOR QUICK DELIVERY; 12 UNITS FURNISH POWER FOR POT LINES; FOUR OTHERS SUPPLY ALL PLANT SERVICES.

When Kaiser Engineers planned the new Kaiser Aluminum and Chemical Corporation plant at Chalmette, Louisiana, they were faced with needing large blocks of power, at specified times, as each pot line was ready to produce aluminum. General Electric turbine-generators were selected, and two 10,000-kw and fourteen 20,000-kw units were ordered because they could be built and installed on time—ready to produce power on schedule.

Six pairs of turbine-generators will deliver 240,000 kw of power to the pot lines. Four other G-E turbines furnish power for all plant services and provide stand-by power.

### ENGINEERS WORK TOGETHER

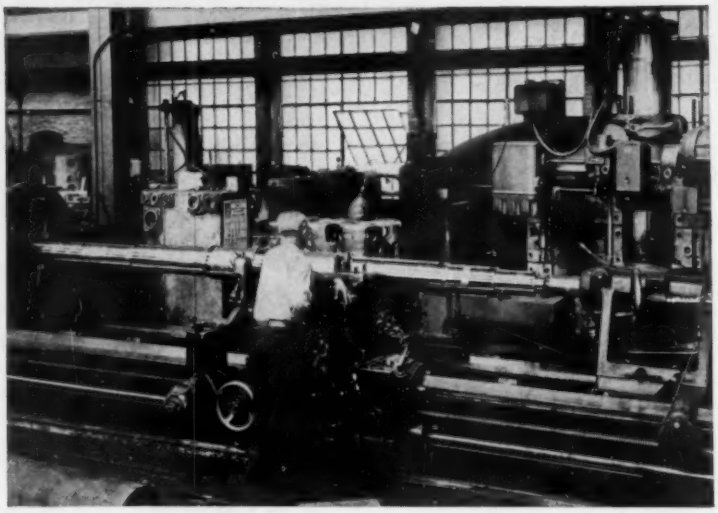
General Electric engineers worked closely with Kaiser Engineers as they do with all companies to achieve over-all project co-ordination on the installation of turbines, switchgear, transformers, rectifiers, etc.

Why not call in G.E.'s experienced engineers to explain the advantages of General Electric equipment in your next turbine installation. If your plant uses quantities of steam, check the economies of G-E automatic-extraction turbines used to supply low-pressure process steam and economical by-product power. Get more for your turbine dollar with G-E turbine-generators. General Electric Co., Schenectady 5, N. Y. 256-6

*You can put your confidence in—*

**GENERAL ELECTRIC**

# When you need a tough, fatigue- and corrosion-resisting alloy —try "K" Monel



This is one of the largest INCO Nickel Alloy pump shafts in the world. The shaft is 13 feet 7⅛ inches long, 9.005 inches at its widest diameter, and weighs 3,343 lbs. It was forged by INCO'S Huntington Mill from "K" Monel for Consolidated Edison Co., after other materials repeatedly failed.

Are there applications in your operation where metal is subject to fatigue, corrosion and erosion?

Then chances are "K" Monel is the alloy you need.

"K" Monel is a tough, corrosion-resisting wrought alloy of nickel, copper and aluminum. It offers you the excellent corrosion resistance of regular Monel, together with the added advantages of greater stiffness and hardness through heat-treating.

As evidence of the value of "K" Monel's added advantages, take a pump shaft operating in highly corrosive and polluted salt water.

New York City's Consolidated Edison Company has two big 80,000-gallon-per-minute condenser circulating water pumps. For years engineers kept replacing the shafts with materials of increasing strength but failures would continue to occur in the same spot because of corrosion fatigue.

Finally, they decided to try "K" Monel.

A 1½-ton heat-treated "K" Monel shaft with a tensile strength of 140,000 pounds per square inch was installed in September of 1949 and has been functioning perfectly ever since. In fact, the pump casing has not even been opened for inspection since installation.

Let's take a quick look at a few of the principal characteristics of "K" Monel:

Age-hardenable, or capable of having its hardness and mechanical properties increased simultaneously as the result of thermal treatment, "K" Monel is equal in strength and toughness to many heat-treated alloy steels. It shows improved strength and hardness at sub-zero temperatures with no loss of toughness. And it provides moderate strength at temperatures up to 900° F.

"K" Monel is non-magnetic under ordinary conditions, and remains so down to —150° F.

The working characteristics of "K" Monel are excellent, too. It is readily machined in an annealed condition, but in other conditions may be considered commercially machinable at practical (although generally somewhat slower) rates. It can be joined by the usual welding, brazing and soldering processes.

You'll find all essential engineering data on "K" Monel and its more machinable companion alloy, "KR" Monel, in the 24-page reference manual, "Engineering Properties of 'K' Monel and 'KR' Monel." Write for a copy so you'll have one handy when you need it. And any time you want help in solving a metal problem, get in touch with Inco's Technical Service Section.

## The International Nickel Company, Inc.

67 Wall Street, New York 5, N. Y.

Inco Nickel Alloys

INCO

MONEL® • "R"® MONEL • "K"® MONEL
"KR"® MONEL • "S"® MONEL • INCONEL®
INCONEL "X"® • INCONEL "W"® • INCOLOY®
NIMONIC® Alloys • NICKEL • LOW CARBON NICKEL
DURANICKEL®

**G-E LIMITAMP** controls the operation of high-voltage motor drives up to 2250 hp . . . gives you quick, silent protection for personnel and equipment against dangerous short-circuit conditions up to 250,000 kva . . . helps prevent costly shutdowns.

# Safety for your personnel and equipment with high-voltage G-E Limitamp Control

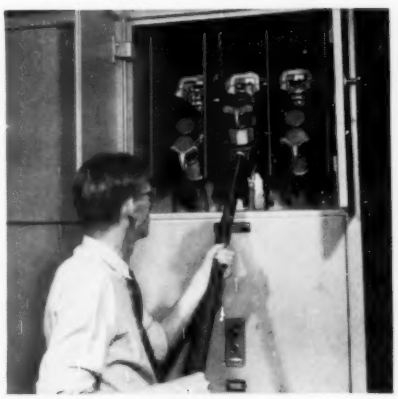
Don't take chances with dangerous short-circuit conditions. G-E Limitamp Control protects against sudden electrical overloads . . . assures greater safety for your personnel and costly electrical equipment. A high-voltage motor control, G-E Limitamp Control provides interrupting capacity up to 250,000 kva.

**MAINTENANCE PERSONNEL** is guarded by a steel barrier separating high- and low-voltage compartments. A mechanical door interlock assures motor circuit interruption before the fuse compartment door can be opened.

**GET EQUIPMENT PROTECTION** with General Electric Type EJ-2 fuses which clear fault current in less than $\frac{1}{4}$ cycle, operate only under actual "short" conditions. Also, improved heavy-duty air-break contactors give you millions of operations.

**FOR YOUR SPECIAL OPERATION** individual components need not be specified. Let G-E application engineers select the correct components, give you the right interrupting capacity . . . better personnel and equipment safety.

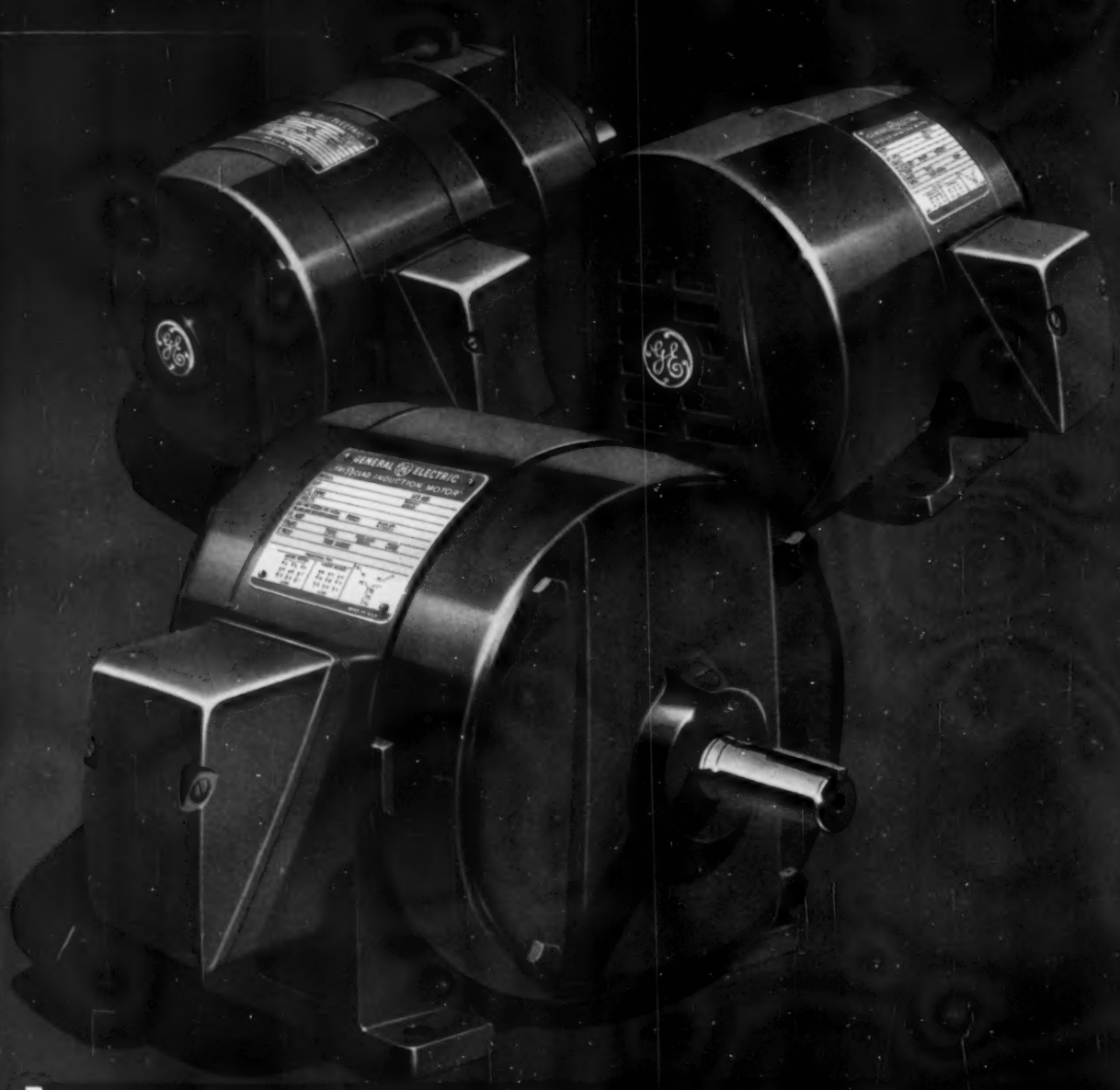
**FOR COMPLETE INFORMATION** about G-E Limitamp Control, contact your nearest G-E Apparatus Sales Office, or write to Section 781-7 for Bulletin GEA-5409 today. General Electric Company, Schenectady 5, N. Y.



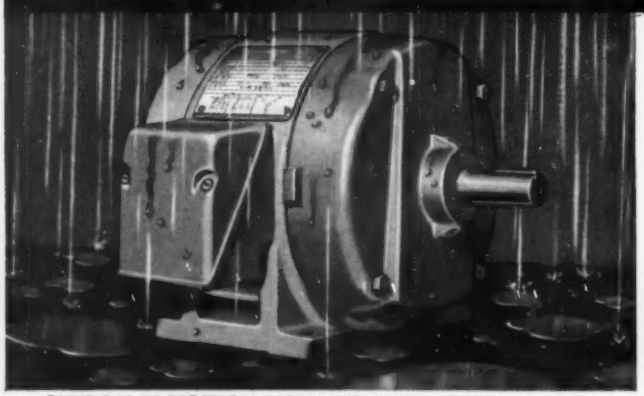
**MAINTENANCE IS EASY . . .** Fuses swing forward on hinges for the disconnect position and fuses can be quickly lifted out.

*You can put your confidence in—*

**GENERAL ELECTRIC**




## YOU GET EVEN LONGER MOTOR LIFE



**PHYSICAL PROTECTION INCREASED 60 PER-CENT** by a complete redesign of cast-iron frame and end shields. This motor is suitable for many jobs where ordinary dripproof motors should not be applied.

**EXTRA ELECTRICAL STRENGTH** is assured by use of new polyester film insulation. A silicone coating, Dri-film,* virtually eliminates stator insulation failure caused by moisture.

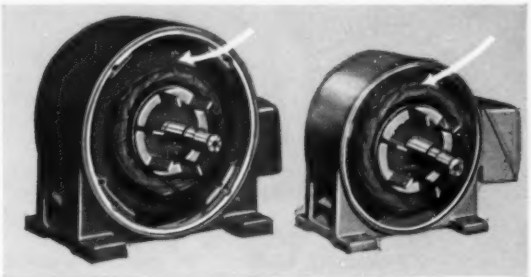
*REG. U.S. PAT. OFF.

**TRI 55 CLAD** REG. U.S. PAT. OFF. THE LEADER IN MODERN MOTOR DESIGN

## GENERAL ELECTRIC ANNOUNCES...

# THE ALL-NEW TRI 55 CLAD MOTOR

REG. U.S. PAT. OFF.



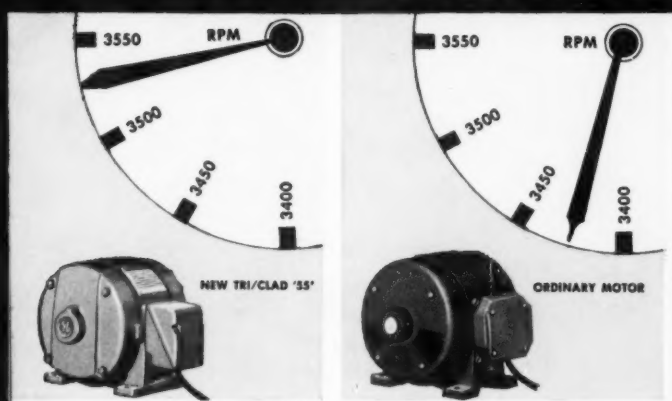
**LIGHTER, SMALLER** Tri/Clad '55' motors have been made possible through better use of space within the frame. Active materials (magnetic steel, copper) have not been sacrificed.

### Complete Line of Dripproof, Enclosed Motors and Gear-Motors Available in Most Ratings in 1954

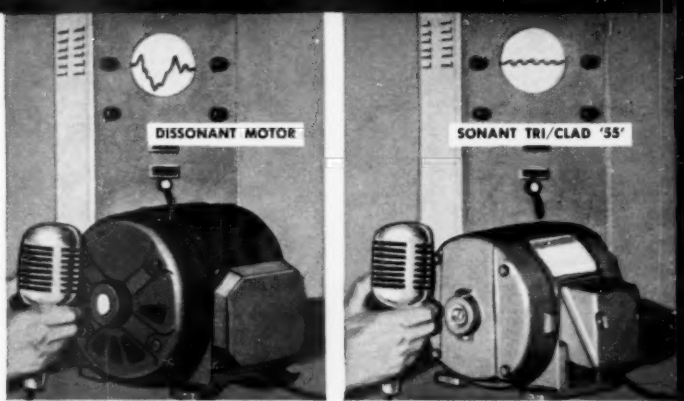
Here's the all-new Tri/Clad '55' motor — now available in NEMA 182 and 184 frame sizes.

You can get complete information on this dramatic motor achievement by writing for bulletin GEA-6013 on Tri/Clad '55' Dripproof motors, GEA-6012 on Tri/Clad '55' Enclosed motors, or GEA-6027 on Tri/Clad '55' Gear-motors, or by contacting your nearby G-E Apparatus Sales Office or G-E Motor Agent. General Electric Company, Section 648-1, Schenectady 5, N. Y.

## YOU GET EVEN BETTER PERFORMANCE




**HIGHER FULL-LOAD SPEEDS** is only one of many improved characteristics of this new G.E. motor. Above shows comparison of an ordinary motor with the Tri/Clad '55' — both rated at 3600 rpm.




**SONANT OPERATION** of the new Tri/Clad '55' motor has been laboratory tested and proven. Motor operates at reduced noise level, and operating sound is pitched to a more pleasant frequency.

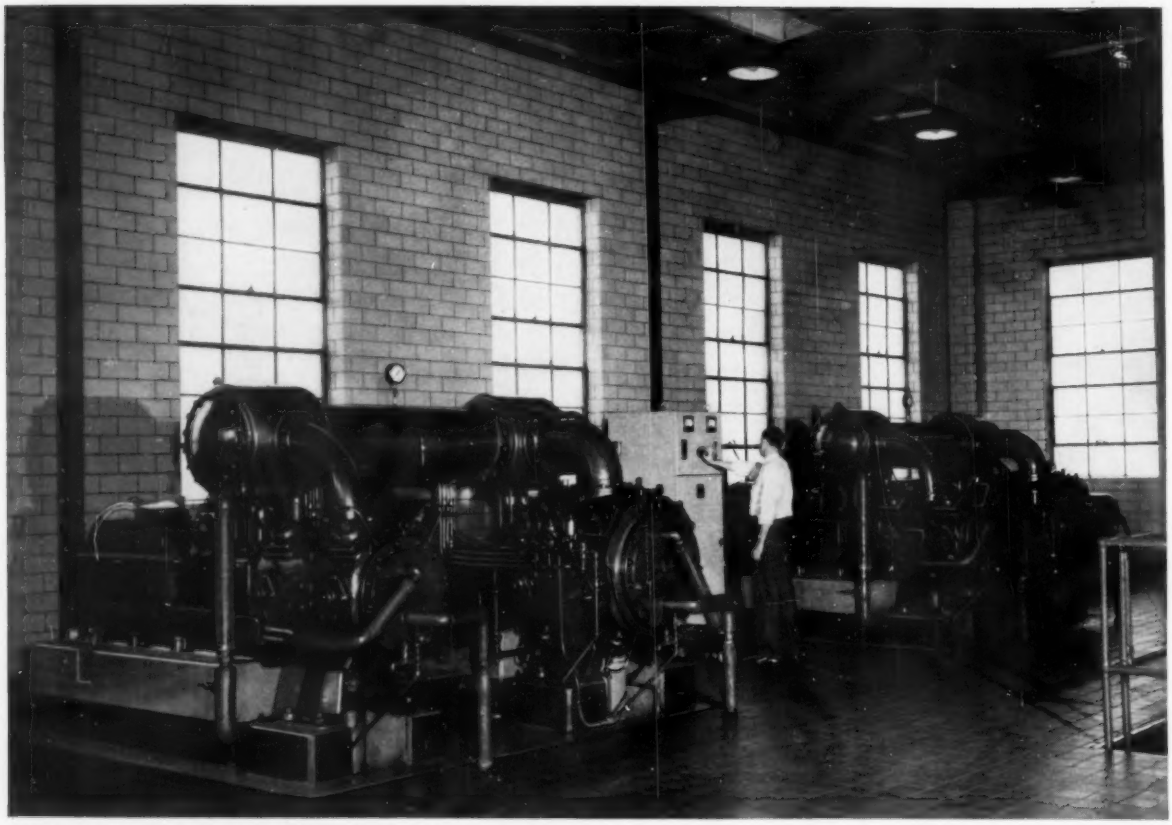
## YOU GET EVEN MORE INSTALLATION AND MAINTENANCE SAVINGS

**NEW BEARING SYSTEM** allows this motor to run longer than other motors without regreasing. One reason—greatly improved synthesized grease with 8 times the mechanical stability of ordinary grease.

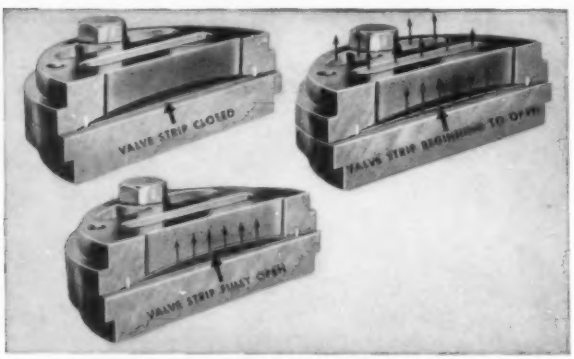
**EASIER TO SERVICE,** the new Tri/Clad '55' has larger conduit box diagonally split for simplified wiring. Perma-numbered leads mean that even clipped and stripped wires are instantly identified.

*Progress is our most important product*

# GENERAL ELECTRIC



**PERFECTION STOVE'S ULTRA-MODERN POWER PLANT** is equipped with two Worthington DC-2 air compressors, each with a capacity of 1000 cfm.




**QUIET-OPERATING WORTHINGTON FEATHER* VALVE** is made up of a series of thin flexible strips of ribbon steel, held in position over rectangular openings by curved milled guards. The valve strips lift and flex uniformly against the curved guards. In addition to quiet operation, the absence of impact results in long valve life and low maintenance costs.

# Perfection called for the finest in air compressors

• The Perfection Stove Company's new Ivanhoe Road power house in Cleveland has received national recognition as a leading example of modern, medium-size power plant design.

Every piece of equipment in this million-dollar plant had to meet the rigid specifications of Perfection's engineers. That's why, when it came time to supply compressed air for general plant use, two Worthington DC-2 horizontal air compressors were selected.

By installing these modern Worthington compressors, Perfection engineers made sure they would get lowest-cost compressed air and longest compressor life. The exclusive Worthington Feather* Valve—the lightest, tightest, most efficient valve made—is largely responsible for that.

Take a tip from Perfection Stove and find out for yourself about the Worthington line of air compressors. Write to Worthington Corporation, Compressor Division, Section K.3.7, Buffalo, N. Y. **Reg. U. S. Pat. Off.*

K.3.7

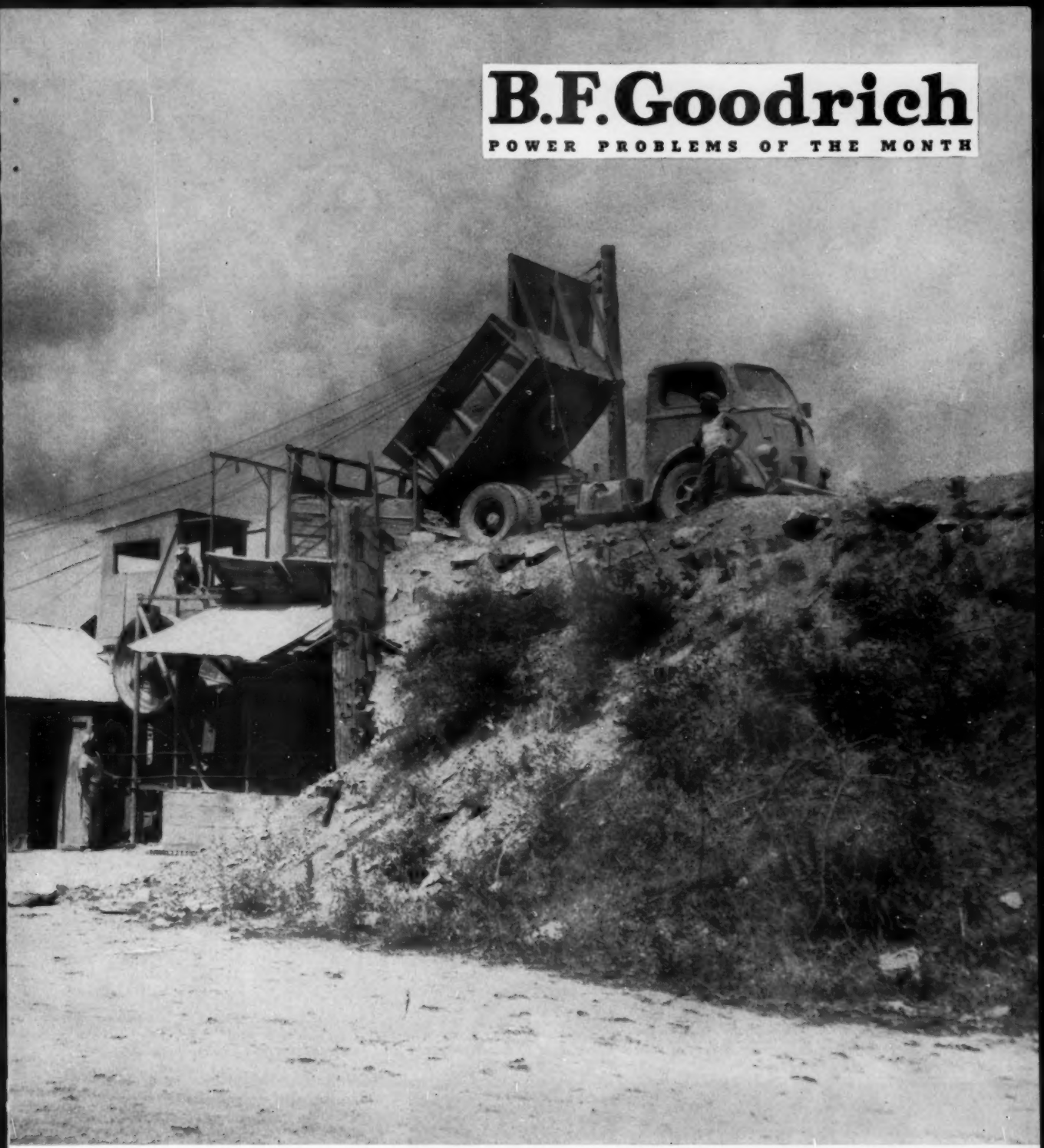
**WORTHINGTON**

**Only Worthington Compressors give you Feather Valve Performance**

**Y-Types • Balanced Angle • Horizontal • Portable • Radial • Gas Engine Compressors**

**B.F.Goodrich**

POWER PROBLEMS OF THE MONTH



*When that machine stops working, rock needed for road building doesn't get crushed, highway construction may be held up.*

# Highway robber arrested

That mass of machinery crushes tons of rock every day. But the jolting action is rough on the V belts used to keep the crusher crushing. Ordinary belts suffered from shock loads, wore out fast. Then the whole plant shut down, costs went up by the minute. It took an unusual V belt to solve these hold-ups—as you'll see on the following pages.

# Highway robber... (continued)

*Jarring, crunching action of rock crusher used to cause frequent and costly production "hold-ups".*

To solve the problem described on the preceding page, a B. F. Goodrich distributor recommended B. F. Goodrich Grommet V belts. These belts look the same, but because they are made in an entirely different way, Grommet V belts stand more jerks and hard pulls than any other kind. When this picture was taken, they'd been at work three years and there had been no shutdowns whatever for maintenance or replacement. Here's why these B. F. Goodrich belts last longer, serve better, save money.

### *Strongest V belt made*

All the load-carrying cords in Grommet belts are concentrated in twin grommets. These grommets are cord loops made like giant twisted cables except that they're endless. Since there are no center cords, the Grommet belt is more flexible, and so can "give" temporarily and absorb shock loads. As a result, Grommet belts last 20 to 50% longer, depending on the service. (The more severe the service, the greater the increase over ordinary belts.)

### *No weak spots*

The section where cords overlap is the weak spot in ordinary belts. That's where 80% of V belt failures occur. But in Grommet V belts this cause of belt failure has been eliminated. The grommets are endless. There are no splices or overlaps—no weak spots to cause premature belt failure.

### *1/3 more gripping power*

Grommet V belts have more rubber in relation to belt size. Without any stiff overlap, they're more flexible, grip sheaves better. Size for size, Grommet belts give ⅓ more gripping power with less slip, pull heavier loads with a higher safety factor. And because there is less slip, there is also less surface wear.

### *Less stretch*

In ordinary belts under tension, the center cords loaf, the outer cords overwork because tension is greater near the driving faces. Grommet belts, with no center cords, have much more strength and less stretch. Grommet belts stretch, on an average, only about ⅓ as much as ordinary belts.

*Spattered by hot grease from gears on a heated kiln.*

# Oven half a block long

Those belts run a giant-size kiln used in making fire brick. The long cylinder must be kept turning 24 hours a day, and that was a major problem. The V belts couldn't take the heat, oil, grease and constant exposure to weather. Time outs for replacements were costly.

A BFG man learned of the trouble and suggested Grommet V belts. While the drive was orginally designed for six belts, a set of four Grommet belts was tried, and has run almost continuously on a 24-hour basis for over a year. This is just one more example of how special compounding of rubber and the husky grommets in B. F. Goodrich V belts can cut operating costs.

This company, like many others, is making a 3-way saving with Grommet V belts. First, they save on replacement costs because Grommet belts last longer. They save on production costs with no shutdowns caused by belt failures. And they save on maintenance costs because these belts need less attention. Yet the savings they make are clear profit because Grommet belts cost not one cent more than ordinary V belts. Next time you need V belts, order Grommet V belts from your BFG distributor. *The B. F. Goodrich Company, Dept. M-179, Akron 18, Ohio.*

Grommet—T. M. The B. F. Goodrich Co.

*Grommet V-Belts* BY

**B.F.Goodrich**

**INDUSTRIAL PRODUCTS DIVISION**

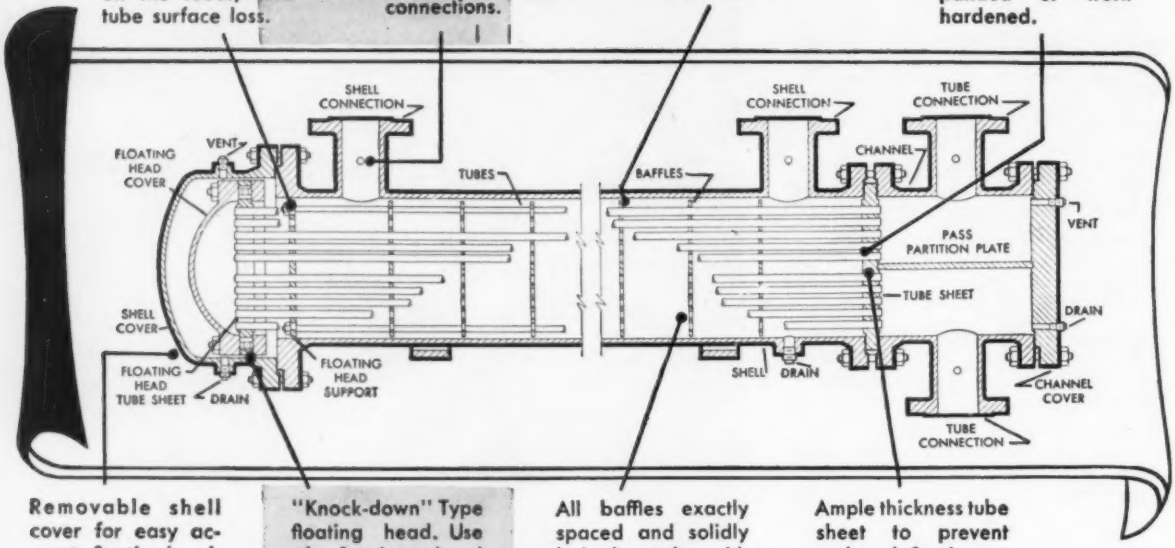
# HEAT EXCHANGER EFFICIENCY starts with SUPERIOR DESIGN

"Do-Nut" shape support plate offers maximum support to the floating head without undue strain on the tubes, and tube surface loss.

Connection for pressure gauge and thermometer provided on all flanged connections.

Baffles — cross flow segmental type machine cut and drilled. Close tolerances assure maximum heat transfer.

Tubes — expanded into tube sheets by means of electronic controlled roller expanders, tubes cannot be over expanded or work hardened.




Removable shell cover for easy access to floating head.

"Knock-down" Type floating head. Use of floating head minimizes thermal expansion strains.

All baffles exactly spaced and solidly bolted together with heavy tie rods and spacers.

Ample thickness tube sheet to prevent undue deflection at pass partition plate.

The features of design which make a heat exchanger good are the features which contribute most to efficient, long-lived, trouble-free performance *under your operating conditions*. Since operating conditions are seldom exactly duplicated, industrial heat exchangers are usually custom-built . . . and design characteristics are different for each application.

But while design characteristics differ, the fundamentals of good heat exchanger construction never change. If you are considering the purchase of heat exchanger equipment, we welcome the opportunity of showing you how SUPERIOR Heat Exchangers combine tested fundamentals with design features that fit your use . . . for performance you can BANK on.

Write for your copy of catalog 6010

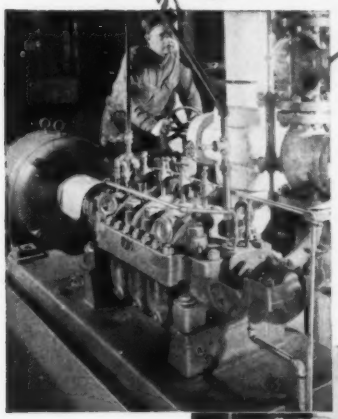
*for performance you can* **BANK** *on*

**SUPERIOR COMBUSTION INDUSTRIES INC.**
**TIMES TOWER, TIMES SQUARE, NEW YORK 18, N.Y.**

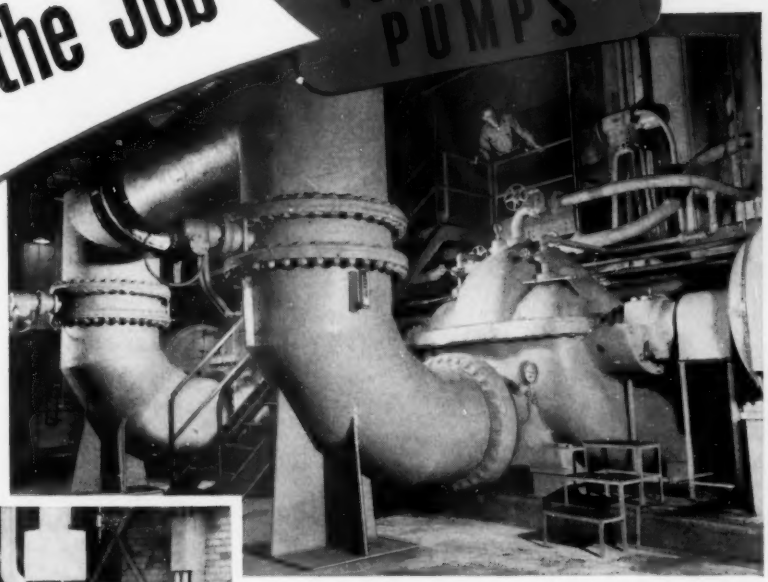
SUPERIOR HEAT EXCHANGERS

# Engineered to Fit the Job

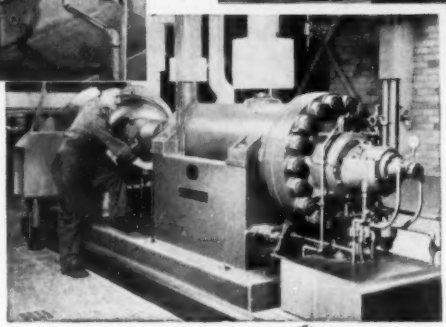
ALLIS-CHALMERS Power-Plant PUMPS

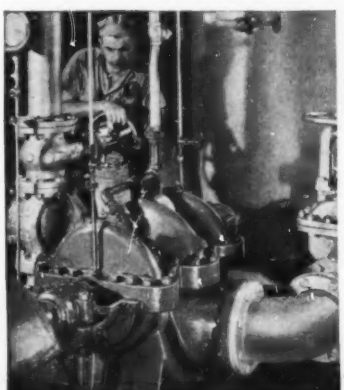


For boiler-feed service, Type M pumps provide heads up to 1200 psig. Barrel-type pumps offer high efficiencies in the pressure range of 1200 to 3000 psig, in ratings from 300 to 2500 gpm. Units shown are (above) 175 gpm, 1325-ft head and (right) 480 gpm, 4271-ft head.



These double-suction centrifugal circulating water pumps are rated 35,000 gpm, 20-ft head. A-C also builds vertical axial and mixed flow types — providing a broad line that covers all installation requirements.





Condensate pumps are designed and built for operating under vacuum and handling liquid at or near its boiling point. They are available in single and multi-stage types for vertical and horizontal mounting.

WHEN YOU TURN to Allis-Chalmers, you get triple insurance that each pump will fit your requirements:

(1) You gain application engineering based on more than 60 years of centrifugal pump experience and research . . . (2) You select from a wide, diversified line, with each pump custom-engineered for its specific job . . . (3) You get pumps that are individually tested, on the most modern test floor in the industry, to assure complete compliance with the specifications.

This triple insurance can cover all of your major pump requirements . . . from high-pressure boiler-feed units to solids-handling ash sluice pumps . . . horizontal or vertical . . . centrifugal, mixed or axial-flow types. You gain by calling in your A-C representative for help.

**WRITE FOR** *Bulletin 52B6059, listing Allis-Chalmers pump types and ratings.*

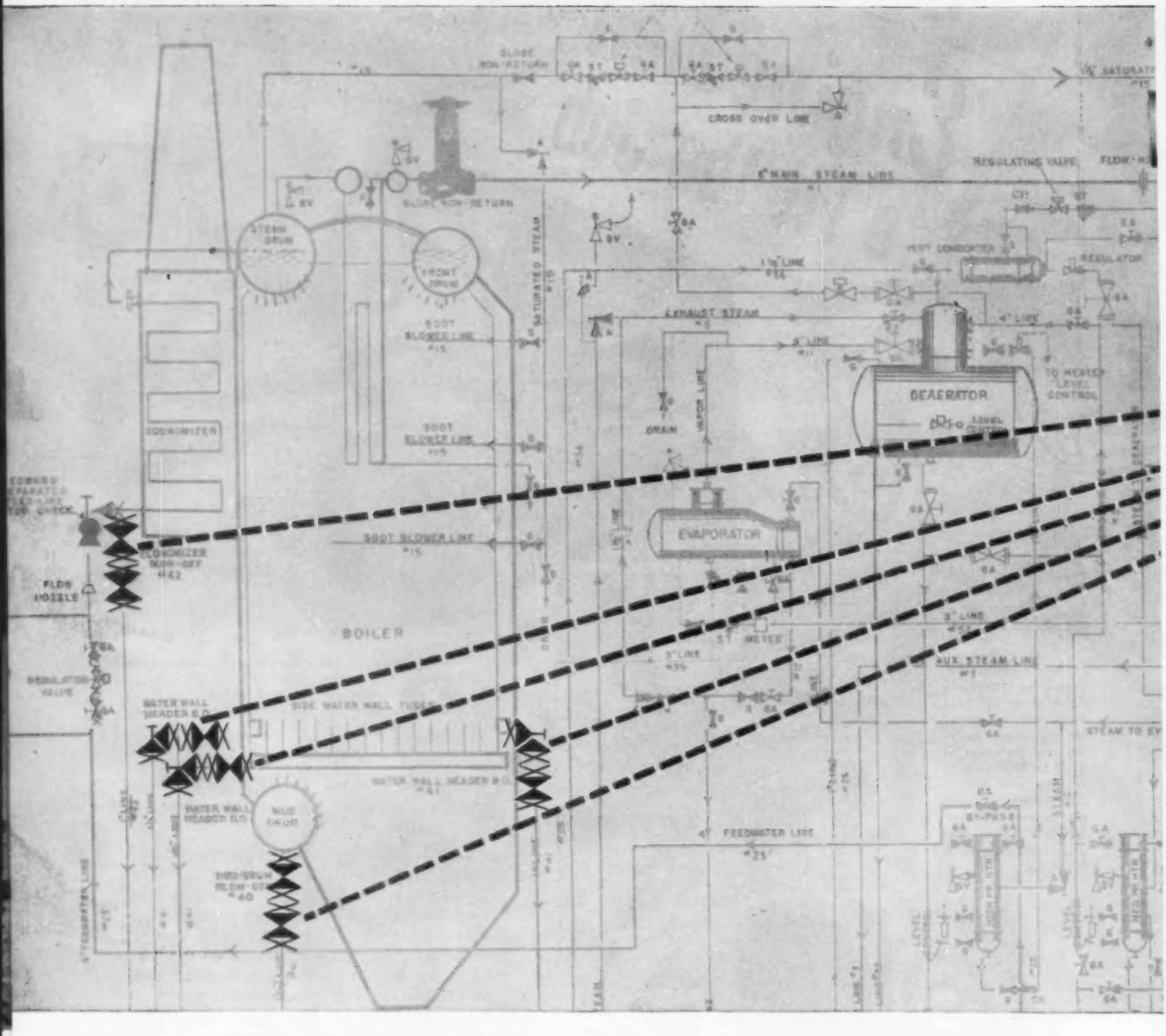
A-4141B

# ALLIS-CHALMERS

A-C ALLIS-CHALMERS

**Milwaukee 1, Wisconsin**

# What you should know about




**In the nearly 50 years since Edward designed and built the first steel blow-off valves, experience and research have revealed many facts about them. Here are some of the most important.**

## OPERATIONAL POINTERS

. . . that will reduce maintenance and extend life of your blow-off valves:

1 During blow-down periods, open valve nearer boiler wide, first; then, slowly open other valve. In shutting down, close second valve first; then valve nearer boiler. This procedure places greatest wear on blowing valve and insures a tight valve next to boiler. Should blowing valve show wear, erosion, etc., it can be repaired or replaced without a boiler shut-down.

2 Open blowing valve slowly to prevent damaging shock to piping. (Edward blow-off valves are slow-opening valves that operate at normal hand-wheel speeds to eliminate errors by inexperienced operators.)

## SELECTION IDEAS

. . . that reduce up-keep costs:

1 Always buy two valves of same type to permit interchangeability of parts. (All Edward blow-off valves sets have interchangeable parts.)

2 Pick blow-off valves with the packing far removed from the high temperature zone. (In Edward blow-off valves packing is above a condensate cooling chamber—out of the high temperature zone.)

3 Select blow-off valves with backseats to protect and isolate packing in service. (Edward blow-off valves have line-contact backseats for positive sealing.)

4 Be certain that in the valve hookup *both* valves will stay tight. (With Edward blowing is the same design as its mate. *Both* are capable of tight shut-off.)

5 Select blow-off valves designed so that the disk *lifts* off the seat on operating instead of grinding against it. This eliminates the possibility of seat-disk galling. (Edward swivel disk construction allows disk to turn on the stem and lift vertically away from seat.)

6 Above all, avoid gadgety, involved designs. You are fundamentally interested in long, dependable service and freedom from maintenance. (Edward blow-off valves are simple in design, and have an excellent record for long, trouble-free life.)

## BOILER CODE REQUIREMENTS

. . . that control blow-off valves:

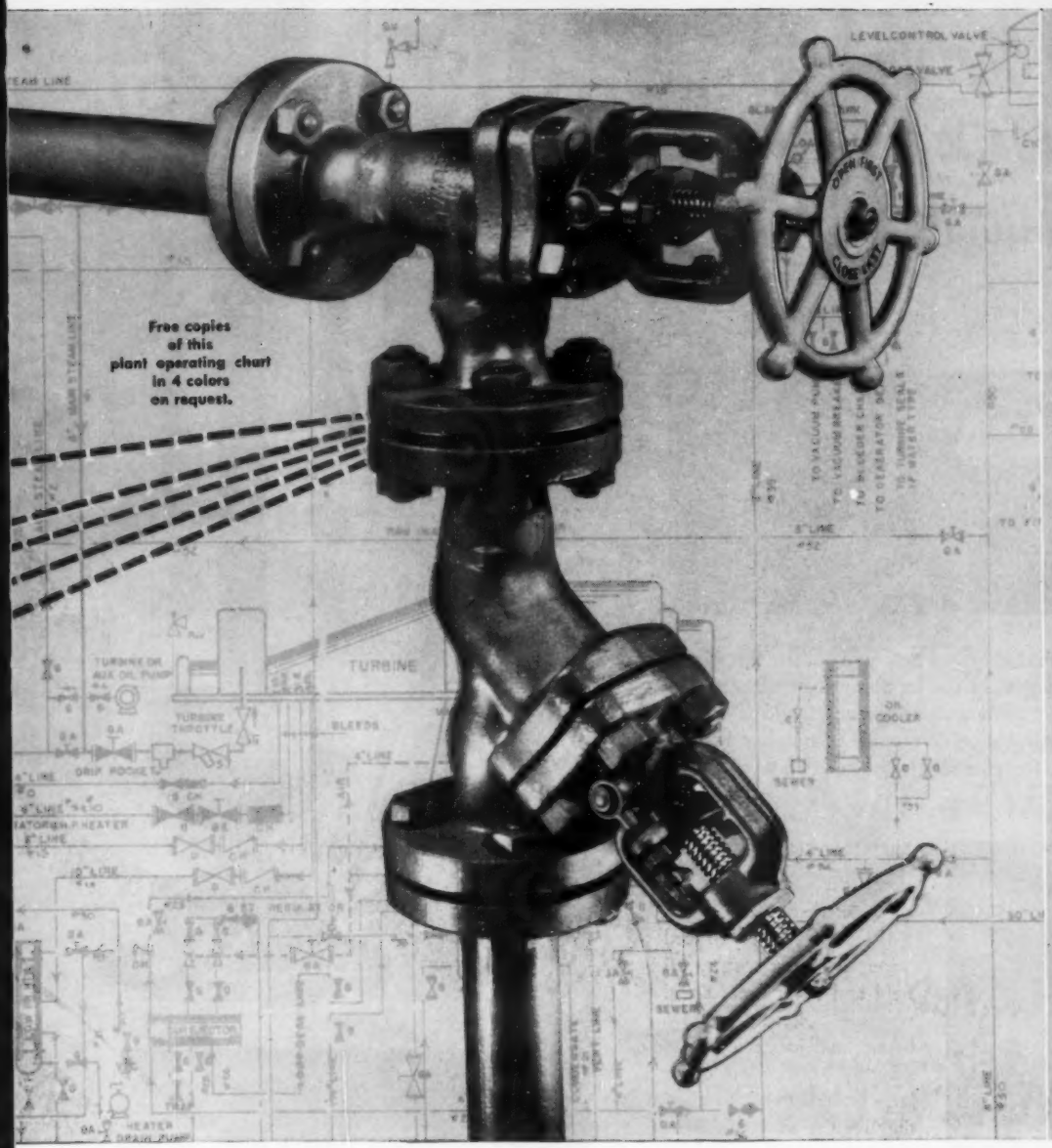
**P-307**

(a) A blow-off as required herein is defined as a pipe connection provided with valves through which the water in the boiler may be blown out under pressure.

**P-308**

(b) Minimum size for pipe and fittings shall be 1 in., and the maximum size shall be 2½ in.

# BLOW-OFF VALVES*




Free copies of this plant operating chart in 4 colors on request.

300 lb sp

600 lb sp

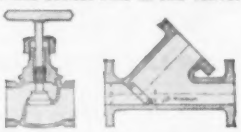
900-1500 lb sp

1500-2500 lb sp

(c) Straight-run globe valves of the ordinary type as shown in Fig. P-43A, or valves of such type that dams or pockets can exist for the collection of sediment, shall not be used on such connections.

(d) Straightway "Y" type globe valves as shown in Fig. P-43B, or angle valves, may be used in vertical pipes, or they may be used in horizontal runs of piping provided they are so constructed or installed that the lowest edge of the opening through the seat shall be at least 25 per cent of the inside diameter below the center line of the valve.

P-43A Type of Globe Valve



P-43B Type of Straightway "Y" Globe Valve

*P-310*

(c) Valves and fittings from the boiler to and including the required stop valves shall be equal at least to the requirements of the American Standards for a pressure 1.25 times the maximum allowable working pressure of the boiler of 1.25 times the lowest set pressure of any safety valve on the boiler drum.

(e) For pressures over 200 psi, the valves or cocks shall be of steel construction equal at least to the requirements of the American Standard for 300 psi.

**Table P-15 Maximum Allowable Boiler Pressure for Feed Line and Blow-off Line under Par. P-310**

| Pressure Class | 100 | 300 | 400 | 600 | 900 | 1500 | 2500 |
|---|---|---|---|---|---|---|---|
| Std. Facing | 150 | 416 | 540 | 785 | 1120 | 1745 | 2625 |
| Ring Joint or Welded Joint | 160 | 515 | 665 | 950 | 1350 | 2080 | 3120 |

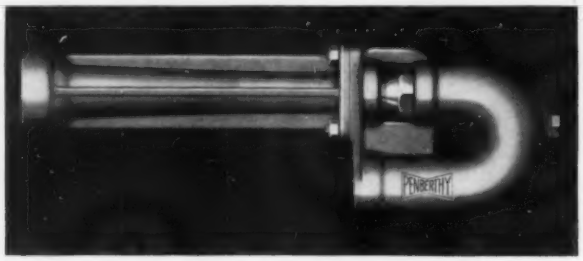
**P-311**

(a) When the allowable working pressure exceeds 100 psi, each bottom blow-off pipe shall have two slow-opening valves, or one slow-opening valve and a quick-opening valve or a cock complying with the requirements of Par. P-310. By "slow-opening" valve is meant one which requires at least five 360 deg. turns of the operating mechanism to change from full-closed to full-opening and vice-versa.

*One of a series providing condensed information on valve applications in steam power plants.

**Edward Valves, Inc.**
Subsidiary of ROCKWELL MANUFACTURING COMPANY
1220 WEST 144th ST.
EAST CHICAGO, INDIANA
Another Product

# There's Certain satisfaction in PRODUCTS BY PENBERTHY



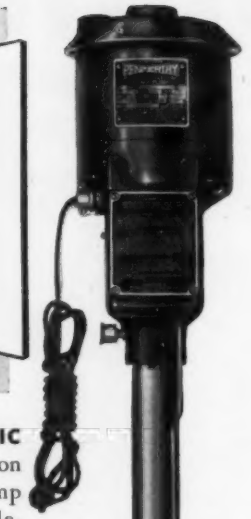
**JET PUMPS**—Penberthy can help you put the simple, economical principles of the jet pump to work wherever it's necessary to transfer or mix any liquid which will flow through a pipe. We make a complete line and have years of engineering experience upon which you can depend.

**AUTOMATIC INJECTORS**

Penberthy injectors are the accepted method of assuring a dependable supply of feed water, at lowest cost, to oil field and other firebox and portable boilers. They are being used increasingly for standby service on many large boilers. Easily installed, they require little or no attention.

**AUTOMATIC CELLAR DRAINERS • WATER HEATERS EJECTORS • HYDRAULIC EJECTORS • EDUCTORS EXHAUSTERS • CYCLING JET PUMPS • SYPHONS**

...are among the other Products by Penberthy which can serve you in your operation. Why not write for literature detailing specifications and advantages. Ask, too, about the engineering service which Penberthy is providing for many prominent concerns in your industry.



**AUTOMATIC ELECTRIC SUMP PUMPS**—Corrosion resistant Penberthy sump pumps are correctly designed and made of copper and bronze throughout. There are 7 sizes, 3 models equipped with trouble-free features to give years of economical, dependable service.

**LIQUID LEVEL GAGES**—Penberthy makes a complete line of gages and valves for every type of application. 70 years of engineering experience is on hand to accommodate your particular requirements. You can always be assured of complete cooperation and reliable product service for any pressure...in any length.

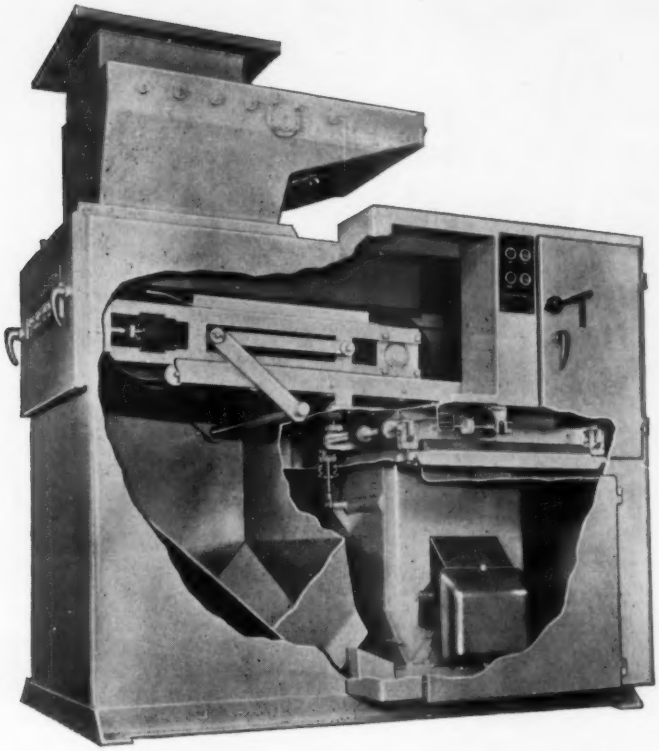
Established 1886

**PENBERTHY INJECTOR COMPANY**

*Division of the Buffalo-Eclipse Corporation*

**1242 Holden Avenue, Detroit 2, Michigan**

***Manufacturers of Quality Products Since 1886***



# *Maintenance Men Know the Inside Story*

*The unique design of the feeder frame, as shown below, provides an easy and quick means of changing an endless belt. This can be done without interrupting flow of coal to the boiler.*

When maintenance men work with S-E-Co. Automatic Coal Scales, they know that they are working with equipment designed and built to give continuous service and which requires an absolute minimum of attention.

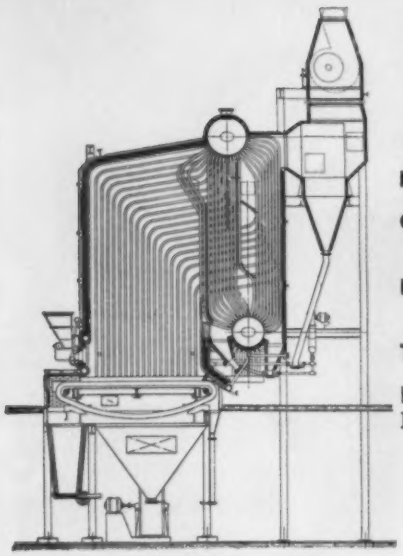
Maintenance men are well aware that the following time and trouble-saving features included in the S-E-Co. Coal Scale will mean better scale performance for your plant:

1. Neoprene rubber feeder belt that is molded endless — offering maximum in long life expectancy.
2. Rigid feeder frame, mounted on rollers, specifically designed for easy removal from scale body and quick changing of feeder belt. (See photograph to left.)
3. Electric counter with no linkage connections to get out of adjustment, cause errors, or need maintenance attention.
4. Large hinged and latched, dust-tight doors which facilitate maintenance by providing easy access to any part of the scale.
5. Electric circuits wired through terminal block, allowing easy check of any or all circuits at one point.

Write for Coal Scale Bulletin No. 61 or for our local representative to call and discuss the application of the S-E-Co. Coal Scale and related equipment to your particular plant problem.

**STOCK EQUIPMENT COMPANY**
**745P HANNA BUILDING CLEVELAND, OHIO**

*Specialists in Bunker to Pulverizer and Bunker to Stoker Equipment*



**MUNITIONS**

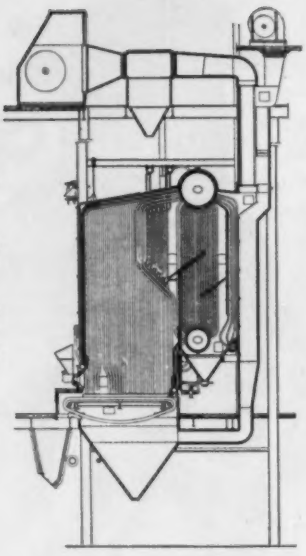
**No. Boilers . . (2)**

**Capacity each**
50,000 lbs./hr.

**Design Pressure**
160 psig

**T. T. Steam** 366 F

**Firing**
Erie City "Travagrate"



**AUTOMOTIVE**

**No. Boilers . . (2)**

**Capacity each**
100,000 lbs./hr.

**Design Pressure**
700 psig

**T. T. Steam** 750 F

**Firing**
Erie City "Travagrate"

# ERIE CITY'S 2-DRUM STEAM GENERATORS

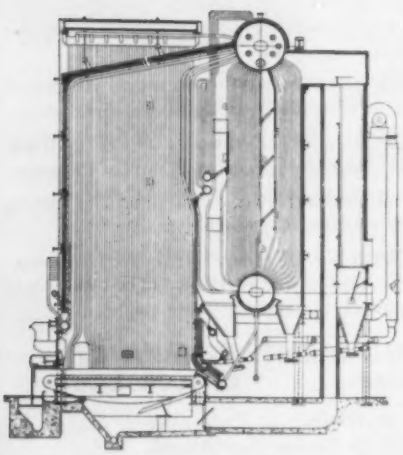
Erie City . . . pioneer in the development of the 2-drum boiler and the application of water walls to furnace design . . . offers a complete, modern line of two, three, or four drum steam generators to solve your most complex problem.

Installations such as shown here indicate the versatility of the Erie City 2-Drum steam generator. The wide range of sizes, adapted to all types of mechanical firing prove its adaptability to all classes of industry. The broad experience of Erie City qualifies it to combine proper boiler selection with efficient use of modern heat recovery equipment and proper application of firing equipment. Add to this the fact that Erie City steam generators are designed to include the best of modern utility standards and then you know . . . "YOU CAN DEPEND ON ERIE CITY FOR SOUND ENGINEERING" . . . is not just a statement. It is a positive fact that can prove to be of value and profit to you.

ERIE CITY
114 Years in Steam Generation

**ERIE CITY IRON WORKS • *Erie, Pa.***

STEAM GENERATORS • SUPERHEATERS • ECONOMIZERS • AIR PREHEATERS
UNDERFEED AND SPREADER STOKERS • PULVERIZERS



**SUGAR**

**No. of Boilers . (2)**

**Capacity each**
150,000 lbs./hr.

**Design Pressure**
450 psig

**T. T. Steam** 570 F

**Firing** Traveling Grate

**CHEMICAL**

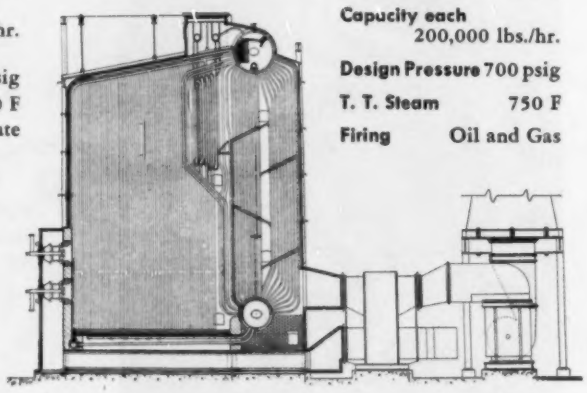
**No. of Boilers . . (3)**

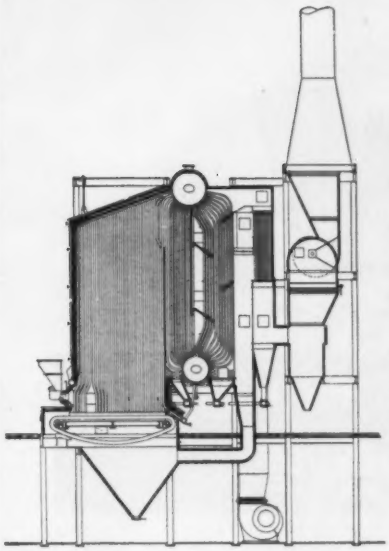
**Capacity each**
200,000 lbs./hr.

**Design Pressure** 700 psig

**T. T. Steam** 750 F

**Firing** Oil and Gas





**U. S. GOVERNMENT**

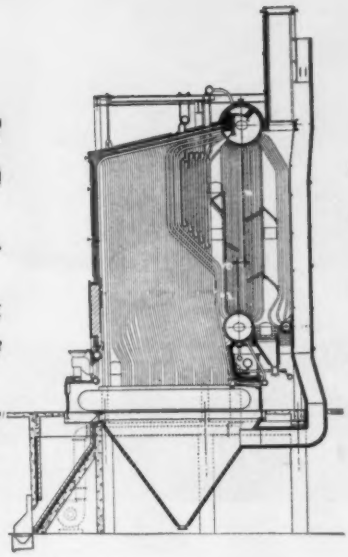
**No. of Boilers . (3)**

**Capacity each**
105,000 lbs./hr.

**Design Pressure**
200 psig

**T. T. Steam** 371 F

**Firing**
Erie City "Travagrate"



**AVIATION**

**No. of Boilers . (8)**

**Capacity each**
135,000 lbs./hr.

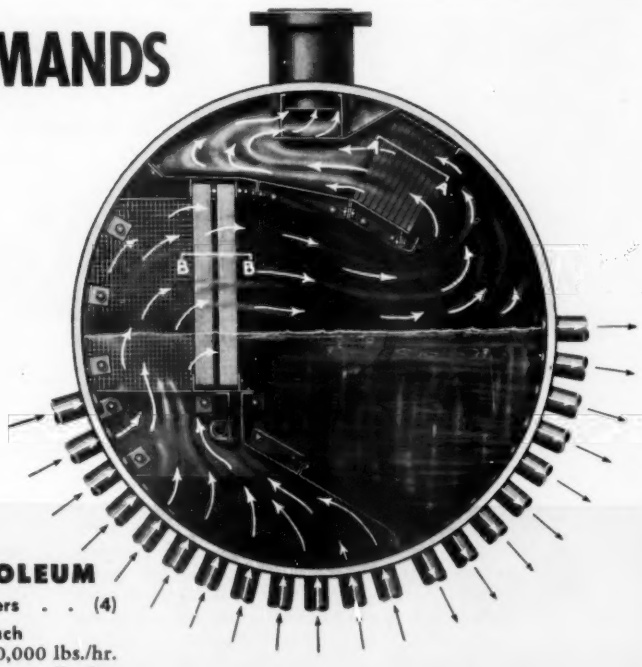
**Design Pressure**
475 psig

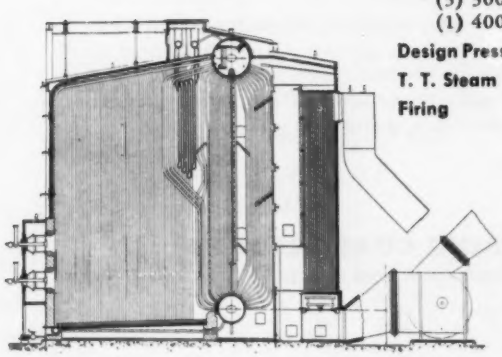
**T. T. Steam** 715 F

**Firing** Chain Grate

# SATISFY BROAD DEMANDS

**All Erie City** 2-drum steam generators are equipped with contact type steam scrubbers. These scrubbers utilize reverse flow and contact with bare corrugated metal surfaces to insure moisture free steam at outlet.





**PETROLEUM**

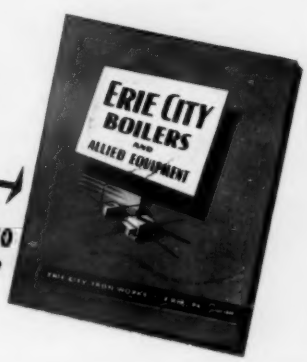
**No. of Boilers . . (4)**

**Capacity each**
(3) 300,000 lbs./hr.
(1) 400,000 lbs./hr.

**Design Pressure** 725 psig

**T. T. Steam** 688 F

**Firing** Oil and Gas

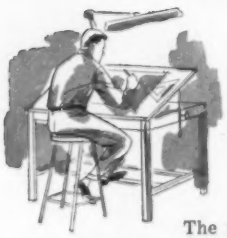



***GENERAL CATALOG SB-50*** *describes the complete line of Erie City Boilers and Allied Equipment.*

# NOW

**. . . the most compact, *complete* burner in the industry for *fully automatic operation!***

# the PEABODY PK-54



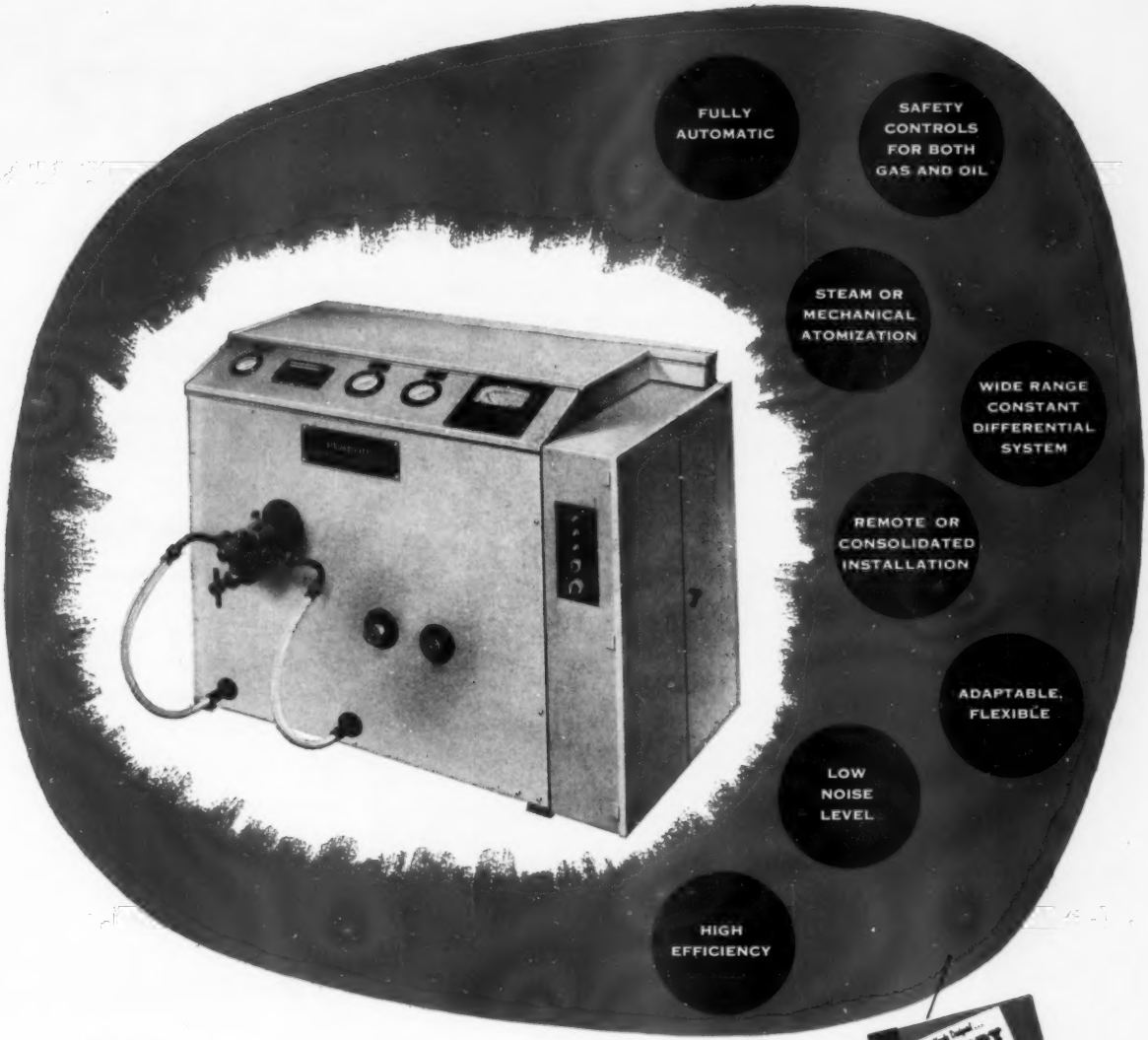
**Designed and built to fire steam generating units with gas or oil, singly or in combination, to 42,000 lbs. steam per hour . . .**

The result of years of research engineering and combustion experience, the modern Peabody PK-54 Burner is the most compact, complete and flexible burner for automatic operation in the industry. Extremely adaptable, the PK-54 is furnished with a factory-packaged control cabinet which can be mounted as an integral part of the unit or remotely located, depending upon job requirements. A fuel oil pump and heater set can also be included if desired. This modern burner features a new and proven air handling arrangement that assures operation with minimum excess air and maximum efficiency over an extended operating range. Wide range steam or mechanical atomizing, utilizing Peabody's constant differential principle of operation is used for oil firing. Continuous combustion and safety controls, for both gas and oil, are only a few of the many unique features built into this, the newest of a long line of burners known for efficiency for more than a quarter of a century.

*Nameplate of Efficiency*

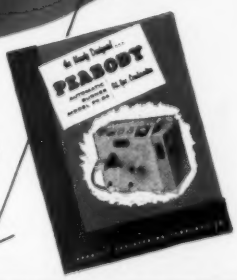
**PEABODY ENGINEERING CORPORATION**

580 FIFTH AVENUE, NEW YORK 36, N. Y.




*The Peabody PK-54 operates throughout an extended burner range and recycles without operator assistance in case of an operational shut-down. Each unit includes burner and blower, as well as an entire system of combustion, safety, and sequential controls—all of which are integrated by a modern design that's been tested and proved to be safe, outstandingly efficient and extremely adaptable.*

Write TODAY FOR YOUR FREE COPY OF BULLETIN 430




**PEABODY**
**ENGINEERING CORPORATION**
[illegible] FIFTH AVENUE, NEW YORK [illegible], N. Y.

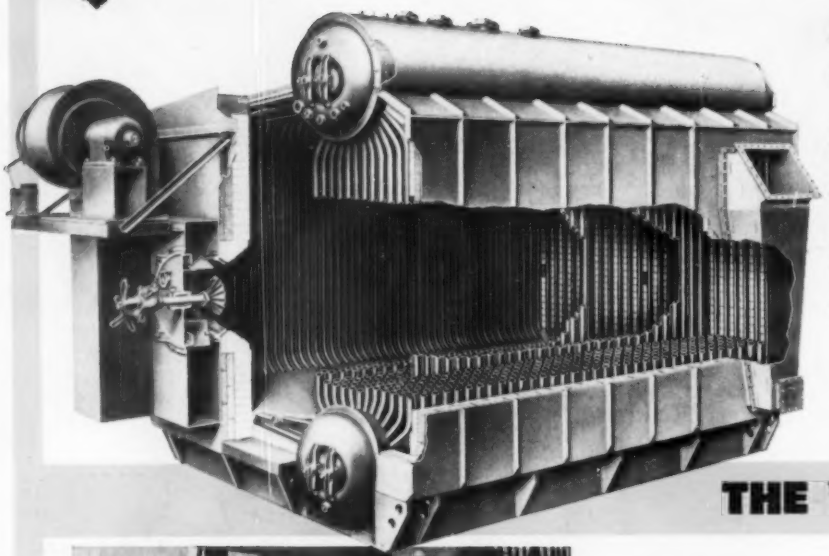
Gentlemen:
Please send me Bulletin 430 giving details and specifications on the Peabody PK-54 Burner.

Name ..... Title .....
Firm .....
Address .....
City ..... Zone ..... State .....

# FOR STEAM CAPACITY
## choose your boiler

**Whatever your fuel . . . whatever your steam capacity requirements up to 60,000 pounds per hour — you'll find one of the C-E Boilers shown here will be just right for you.**

**If you burn oil or gas, investigate the VP Pack-**



### *Specifications — VP Boiler*

**Capacity** — 4,000 to 30,000 pounds of steam per hour

**Pressures** — Up to 250 pounds per square inch

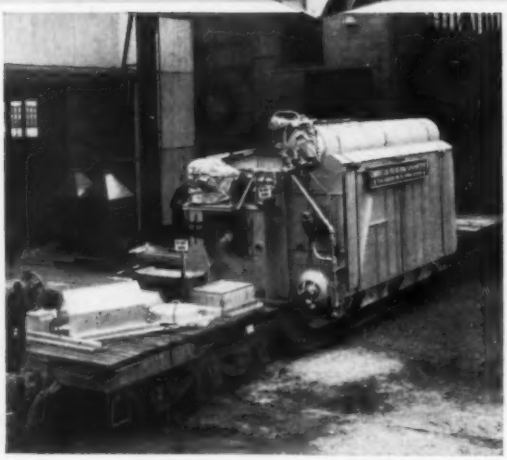
**Temperature** — No superheat

**Fuel** — Oil or gas

**Erection** — Completely shop-assembled

**Foundation** — Simple concrete slab

## THE VP BOILER



The C-E Package Boiler, Type VP . . . completely shop-assembled . . . for oil or gas firing. The VP Boiler has more water-cooled area per cubic foot of furnace volume than any other boiler of its size and type. The large (30-in. diameter) lower drum permits a simple, symmetrical, tube arrangement . . . greater water storage capacity . . . easy access for washing down or inspection. The centrifugal fan is efficient, yet its noise level is less than half that of typical high-speed blowers used on most package boilers. Baffle arrangement is simple, resulting in low draft loss . . . simple soot blowing . . . elimination of dead pockets . . . high heat absorption. Write for Catalog VP.

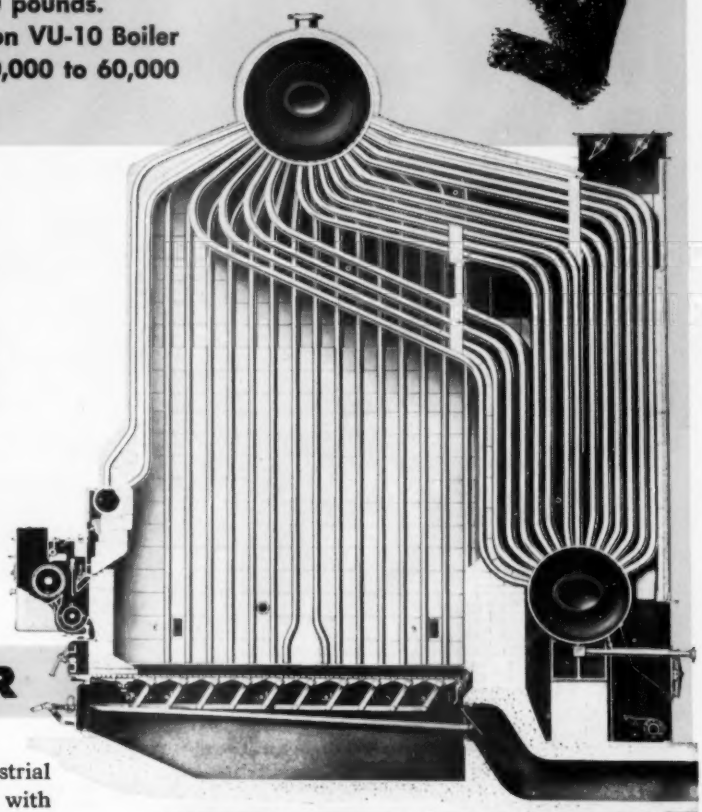
# COMBUSTION ENGINEERING

**Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.**

# UP TO 60,000 POUNDS
## from these two

age Boiler for capacities up to 30,000 pounds per hour . . . the VU-10 up to 60,000 pounds.

For stoker firing, the Combustion VU-10 Boiler is available in capacities from 10,000 to 60,000 pounds of steam per hour.



### *Specifications — VU-10 Boiler*

**Capacity** — 10,000 to 60,000 pounds of steam per hour

**Pressures** — Up to 475 psi

**Temperatures** — Superheat available if desired

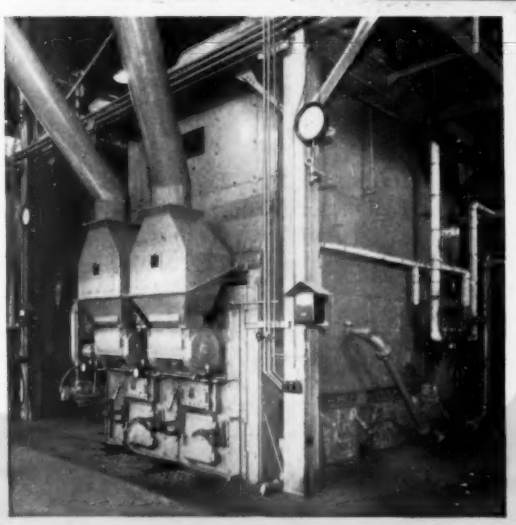
**Heat Recovery** — Economizers, air heaters available if desired

**Fuel** — Coal (C-E Spreader, Traveling Grate or Underfeed Stoker); oil or gas.

**Erection** — Field erected

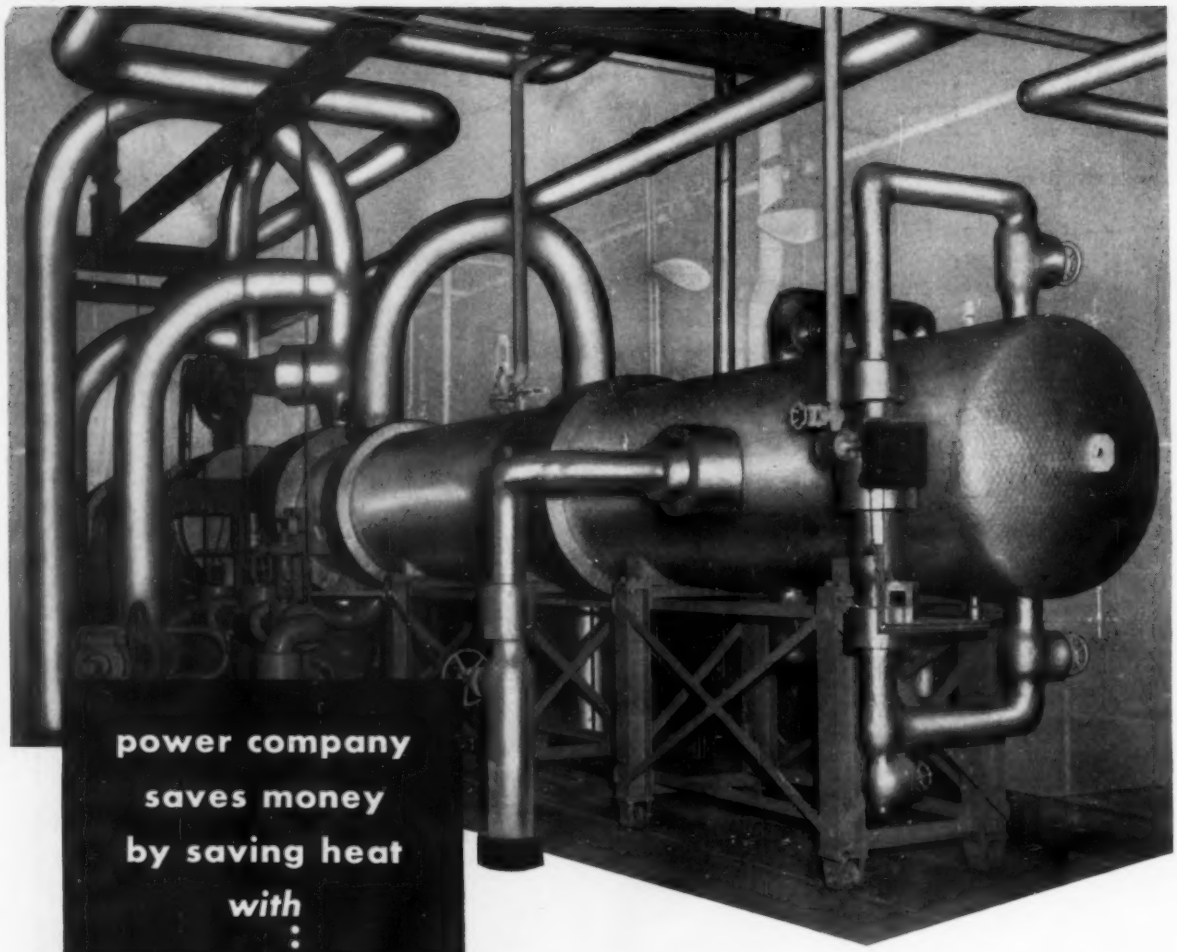
## THE VU-10 BOILER

The VU-10 Boiler is designed for industrial load conditions, particularly for plants with small operating and maintenance forces. Fuel can be either coal, oil or gas. This boiler is a completely standardized design adaptable to many conditions. It responds readily to variations in load; it is simple to operate and maintain. All parts are easily accessible for inspection. Like the VP, the VU-10 Boiler is a complete unit – boiler, furnace setting, fuel-burning equipment, controls, forced draft – bringing you the benefit of one contract . . . one guarantee . . . one responsibility. Write for Catalog VU. 10-8. B-689



C-E

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE.



power company saves money by saving heat with

Steam heater insulated with "Featherweight" 85% Magnesia blocks and K&M asbestos cement. Meramec Power Plant, Union Electric Co., St. Louis, Mo. Insulation Contractor: Armstrong Cork Company

## "Featherweight"® 85% MAGNESIA

In Union Electric Company's Meramec Power Plant, "Featherweight" 85% Magnesia was used to insulate the steam heater pictured above. Such an application is a typical one for dependable "Featherweight."

By itself this material (85% basic carbonate of Magnesia and asbestos fiber) is effective on piping and equipment with temperatures up to 600° F. Used with K&M Hy-Temp Insulation (diatomaceous silica), its range is extended to 1900° F.

Hy-Temp is applied directly to the hot surface, and "Featherweight" is used as the second layer. The two insulations are applied with staggered vertical and horizontal joints—thus eliminating heat loss which occurs on single layer installations when the expansion of hot piping and equipment causes the joints to open.

This K&M combination insulation will last the life of the equipment it serves, will withstand moisture, alternate heating and cooling, wetting and drying. Both materials are supplied in various sizes and thicknesses.

Your K&M distributor is an experienced applicator who will gladly give you more information about these heat-saving, money-saving K&M insulations. Or write directly to us.

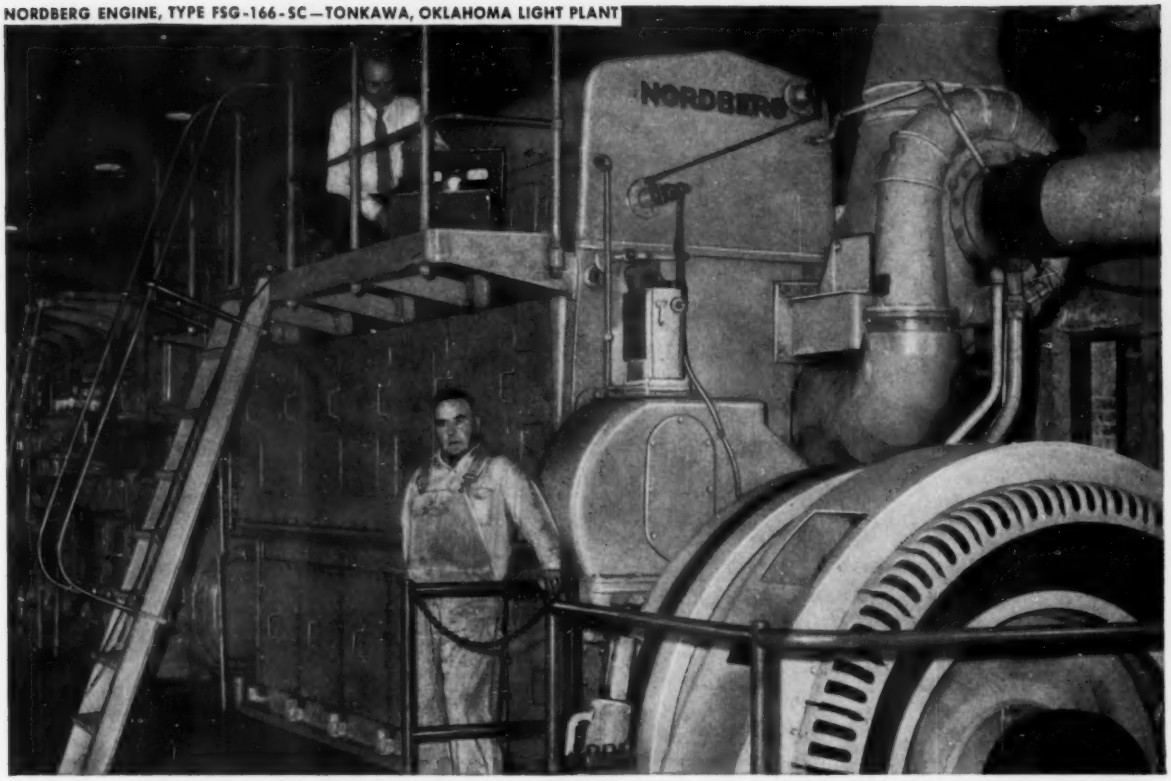
**KEASBEY & MATTISON** COMPANY • AMBLER • PENNSYLVANIA

*Nature made asbestos . . . Keasbey & Mattison has made it serve mankind since 1873*

*In Canada: Atlas Asbestos Co., Ltd., Montreal, Toronto, Winnipeg, Vancouver*

K&M best in asbestos ®

NORDBERG ENGINE, TYPE FSG-166-SC—TONKAWA, OKLAHOMA LIGHT PLANT




# 30,000 HOURS, NO WEAR!

| MICROMETER MEASUREMENTS | | | |
|---|---|---|---|
| LINER MEASUREMENTS | | WITH CRANK | 90° TO CRANK |
| #1 Liner | Top | 16.004" | 16.008" |
| | 4" down | .003" | .006" |
| | 8" down | .0035" | .007" |
| #2 Liner | Top | 16.003" | 16.002" |
| | 4" down | .002" | .001" |
| | 8" down | .001" | .0005" |
| #3 Liner | Top | 16.005" | 16.007" |
| | 4" down | .004" | .006" |
| | 8" down | .003" | .008" |
| #4 Liner | Top | 16.003" | 16.004" |
| | 4" down | .004" | .005" |
| | 8" down | .001" | .002" |
| #5 Liner | Top | 16.004" | 16.000" |
| | 4" down | .003" | .000" |
| | 8" down | .003" | .001" |
| #6 Liner | Top | 16.003" | 16.0015" |
| | 4" down | .0015" | .0015" |
| | 8" down | .0015" | .0005" |
| (Original machine shop tolerance—16" plus or minus .001") | | | |

## No Wear On Rings Or Liners With Great Cities Service Diesel Oils!

When the Tonkawa City people pulled this Diesel off the line for periodical inspection, it had logged 30,038 hours and was approximately six years old. After they had the engine torn down, micrometer measurements were taken on the cylinder liners. THEY COULD FIND VIRTUALLY NO APPRECIABLE WEAR ON RINGS OR LINERS!

They were so amazed that they had another man in the plant take his own micrometer readings. Still not certain that an engine could run that long with so little wear, they had the micrometer itself checked! The instrument checked out perfectly!

Men who have worked with Diesel Engines all their lives have said that they've never seen an engine with that much time in service with so little wear. Obviously, a great deal of the credit must go to the maker of these splendid engines, but also, credit must be given to the high-quality, wear-reducing Cities Service Diesel Oils used in this engine. You'd be wise to buy yourself this kind of inexpensive diesel-engine protection too. Call your nearest Cities Service Office or write Cities Service Oil Company, Sixty Wall Tower, New York City 5, N. Y.

CITIES SERVICE
QUALITY PETROLEUM PRODUCTS

Here's

the

# BIG TRUTH*

about

boilers...

***The only safe way to select boilers is on nominal capacity to operate at "cruising speed"...***

# KEWANEE

**reserve plus rating**

**guarantees** dependability, higher efficiency, lower costs, longer life—because it means "cruising speed" operation.

There's a lot of confusion in sizing boilers today because rating methods have not been brought into the open with a clear-cut definition. That's all changed with Kewanee Reserve Plus Rating. Here for the first time these truths are stated: Only nominal-rated boilers with built-in reserve *safely provide* efficiency—low maintenance—dependability—longer life. Only nominal-rated boilers *safely provide* for fluctuating loads—emergencies—expansion.

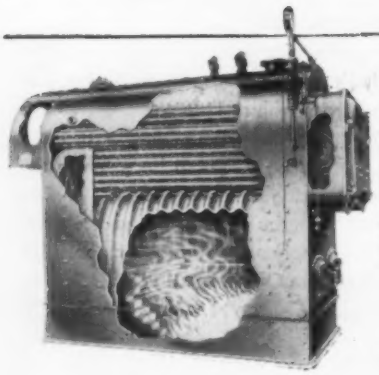
So when you consider "bidding data" be sure you compare like examples . . . know whether ratings are based on maximum capacity or nominal capacity.

Follow the Kewanee Reserve Plus Rating Plan which is based on the commercial code of the Steel Boiler Institute. Kewanee Reserve Plus certifies 50% or more extra power for pick-up and additional capacity. Kewanee gives you complete data and dimensions, so you can realistically consider sizing requirements..

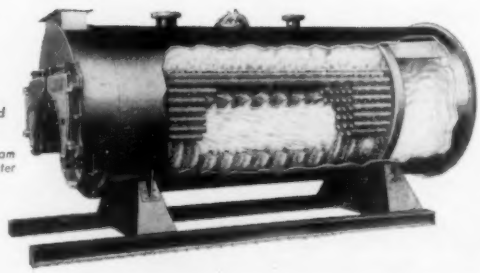
***You can count on* KEWANEE *engineering***

**KEWANEE-ROSS CORPORATION • KEWANEE, ILLINOIS**
**Division of American Radiator & Standard Sanitary Corporation**

***Serving home and industry*** • American-Standard • American Blower Church Seats & Wall Tile • Detroit Controls • Kewanee Boilers Ross Exchangers • Sunbeam Air Conditioners



***Kewanee type "C" boiler***
*with exclusive corrugated crown sheet. 16 sizes for oil, gas or stoker 3650—42500 sq. ft. steam 5840—68000 sq. ft. water*

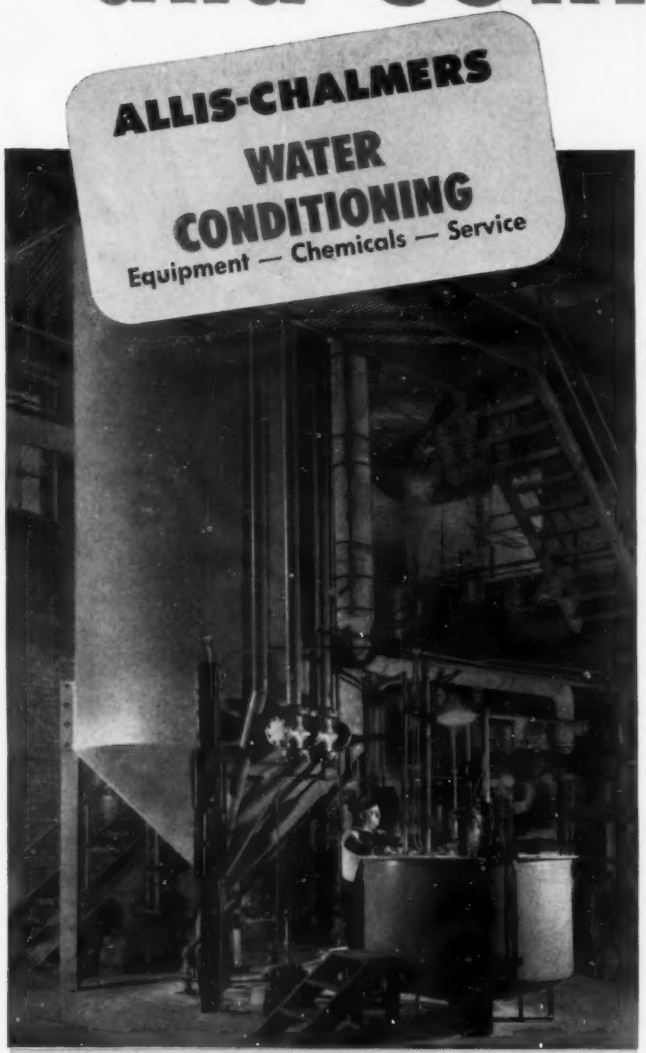


KR-17

***M-800 series boiler***
*Here is rugged "M-800" Series Scotch Boiler constructed in 13 sizes for high pressure steam 30 to 304 horse power and low pressure 15 lb. steam or 30 lb. water.*

# Gilbert Paper Co., Menasha, Wis.

# Prevents SCALE and CORROSION




Equipment at Gilbert Paper Company includes hot process lime-soda softener and chemical feeder. For more information on this process, write for Bulletin 28B6611.

**To prevent** scale and corrosion in water used for steam generation, Gilbert Paper Company removes mineral constituents and dissolved gases by using Allis-Chalmers hot process lime-soda water conditioning. As a result, boiler outages and maintenance are greatly reduced. The process is the same as that used in many installations for process water.

### What Hot Process Lime-Soda System Does

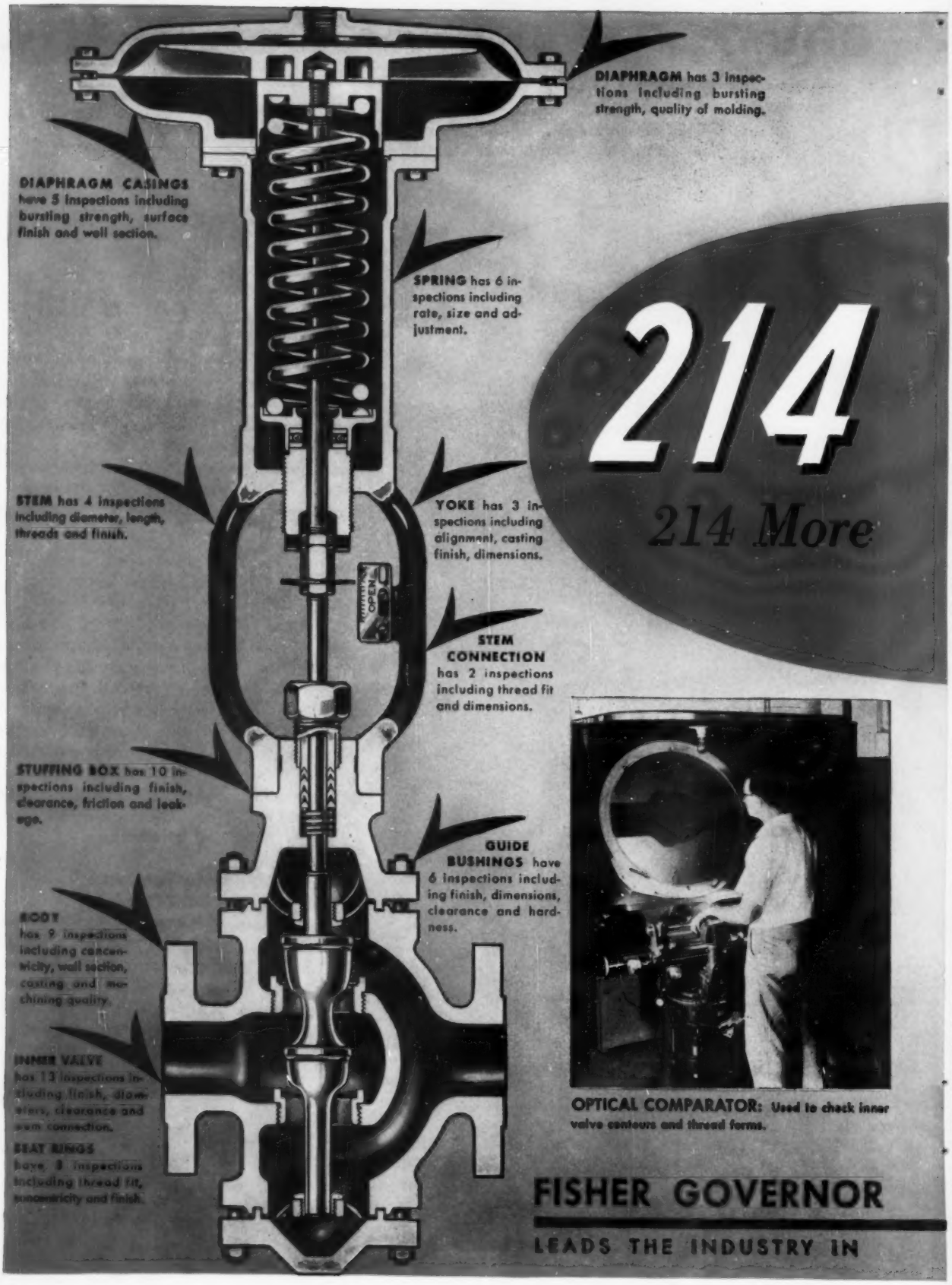
The complete installation heats water to the boiling point for removal of corrosive gases. Proportioning equipment introduces chemical reagents continuously and precisely into the water being treated. Precipitate induced by the thermo-chemical reaction is coagulated, settled, and separated from the water, which is then ready for use in steam generation. Apparatus includes a chemical solution tank, chemical proportioner and pump, reaction and sedimentation tank, pressure filters and accessories.

### How You Can Solve Your Water Problems

If you have a water problem, you'll find Allis-Chalmers complete service a useful addition to your power or process water operations. Many years of experience plus a complete line of equipment and chemicals enable Allis-Chalmers water conditioning experts to recommend sound, economical solutions to your problems. For help with your water conditioning, call the Allis-Chalmers district office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4190

# ALLIS-CHALMERS


DIAPHRAGM has 3 inspections including bursting strength, quality of molding.
DIAPHRAGM CASINGS have 5 inspections including bursting strength, surface finish and wall section.
SPRING has 6 inspections including rate, size and adjustment.
214
214 More
STEM has 4 inspections including diameter, length, threads and finish.
YOKE has 3 inspections including alignment, casting finish, dimensions.
STEM CONNECTION has 2 inspections including thread fit and dimensions.
STUFFING BOX has 10 inspections including finish, clearance, friction and leakage.
GUIDE BUSHINGS have 6 inspections including finish, dimensions, clearance and hardness.
BODY has 9 inspections including concentricity, wall section, casting and machining quality.
INNER VALVE has 13 inspections including finish, diameters, clearance and stem connection.
SEAT RINGS have 8 inspections including thread fit, concentricity and finish.
OPTICAL COMPARATOR: Used to check inner valve contours and thread forms.
FISHER GOVERNOR
LEADS THE INDUSTRY IN

QUALITY CONTROL

FISHER®

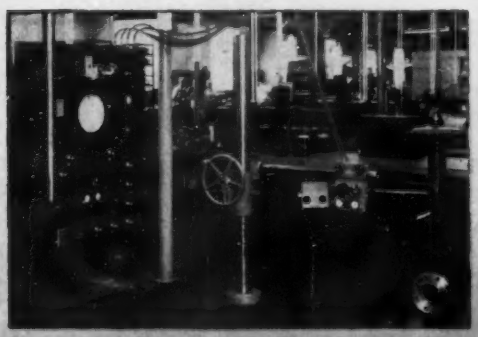
# Inspections

*Reasons* WHY FISHER GIVES YOU MORE FOR YOUR MONEY!

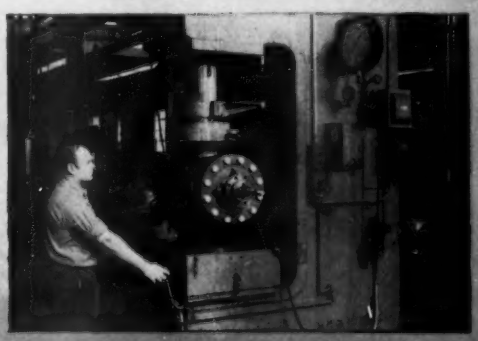
*Automatic Controllers*

**Pressure Regulators — Pump Governors — Liquid Level Controllers — Pilot Operated Regulators — Lever and Float Valves — Intermitters — Gas Regulators — Valve Positioners**

Here at Fisher we believe that *inspection makes perfect.* That's why *every* Fisher Automatic Controller is subjected to an *expert* and *comprehensive* inspection procedure. Typical of this rigid quality control program is the inspection schedule of the Fisher Type 57T diaphragm motor valve illustrated, with a few of the more prominent inspections indicated. From "start to finish", a total of *214 inspections* assures *long trouble-free service* in meeting the most exacting operating requirements. Yes, this Fisher *insistence on perfection* is another example of why Fisher Automatic Controllers always give you *more for your money!*



**HYSTERESIS TEST PANEL:**
To detect misalignment, friction and check range of operation. Certified test certificates on specification.



**HYDROSTATIC TESTING MACHINE:**
Hydraulic pressure testing procedure for casting soundness, as prescribed by ASA.

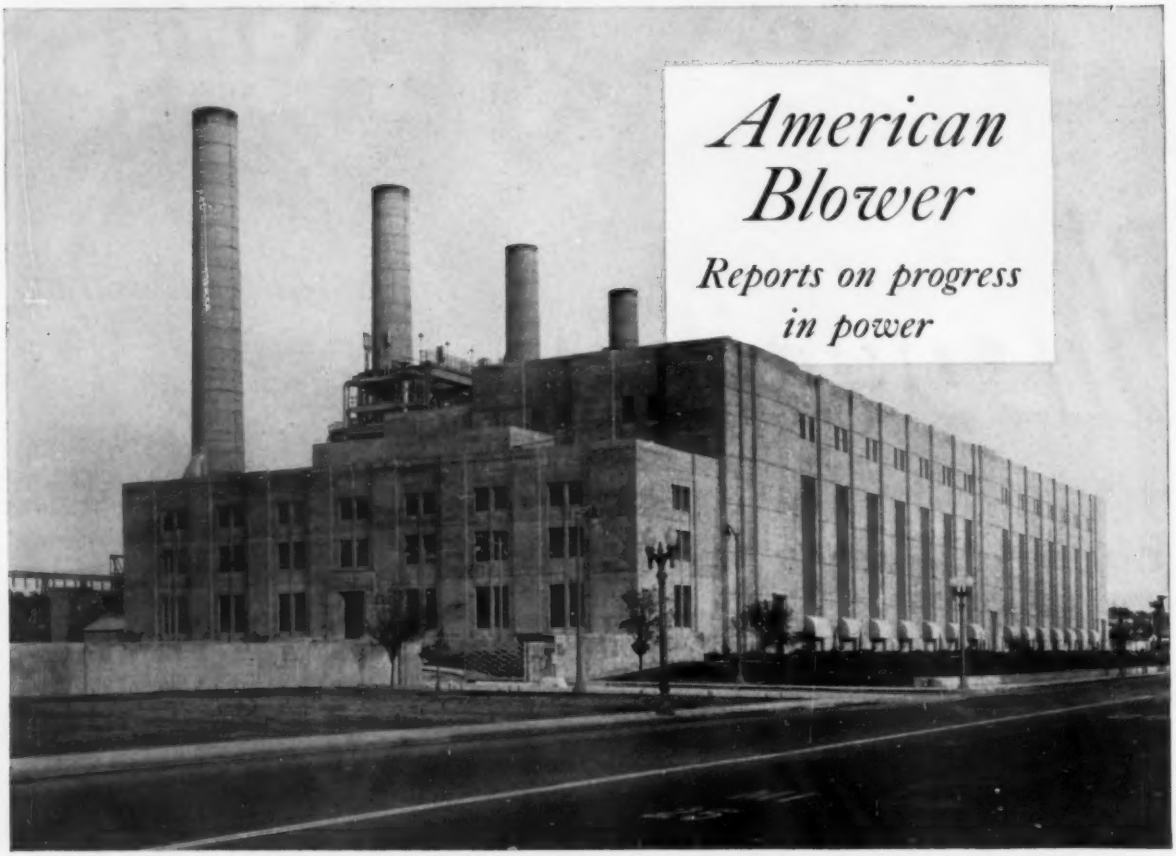
**COMPANY • Marshalltown, Iowa**

RESEARCH FOR BETTER PRESSURE CONTROL

FISHER

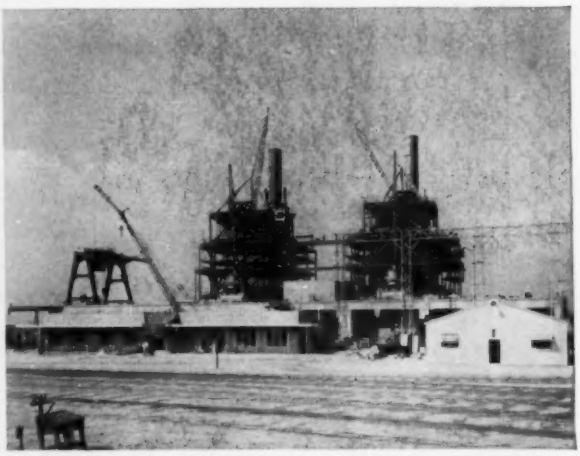
*Since 1880*

# So. Cal. Edison plans ahead with




Southern California Edison Company's Redondo Steam Station, completed in 1949, has a generating capacity of 288,000 kw.

Construction is now under way on Redondo Steam Station No. 2. When completed, it will have two 156,000 kw. generating units.



Etiwanda Steam Station has two generating units with a capacity of 250,000 kw. They went into operation in 1953.

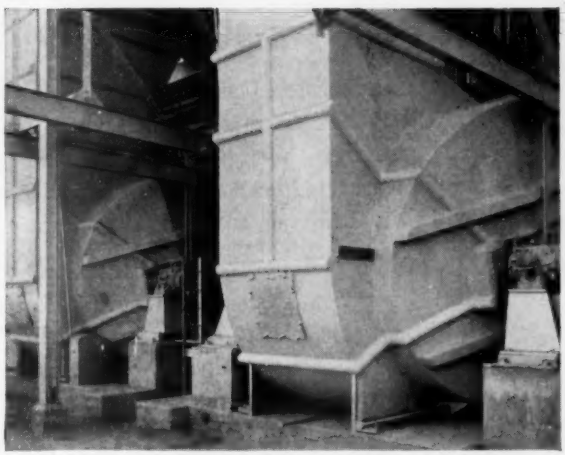
*Serving home and industry:* **AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS &**

# $490 million expansion program

Keeping pace with the record growth of its service territory in Central and Southern California is a full time job for the Southern California Edison Company.

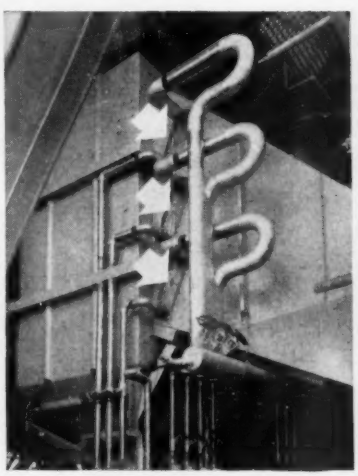
Since 1945, Southern California Edison has spent $490,000,000 for plant expansion alone. And the end is not yet in sight. When the first units at Redondo Steam Station No. 2 and the El Segundo Steam Station are completed, the Company will have a total generating capacity, both steam and hydroelectric, of a mighty 2,329,420 kilowatts.

American Blower products played an important part in Southern California Edison's expansion plans. If you are planning to modernize or expand, let American Blower's wide experience work for you. Consult the nearest American Blower Branch Office or write us direct.

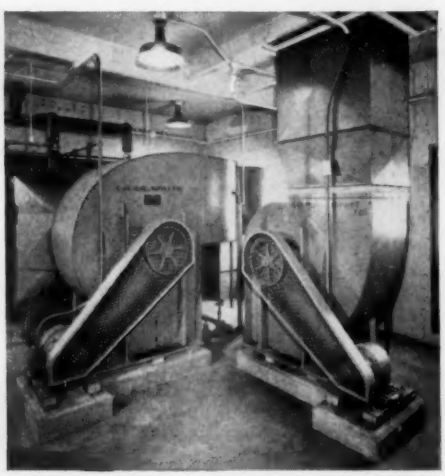


American Blower Induced Draft Fans are installed at Southern California Edison's Etiwanda Steam Station.

American Blower Tubeaxial Fan is designed to supply a wide range of volumes at medium pressures.



Southern California Edison's Etiwanda Station uses American Blower Heavy Duty Steam Coils (arrows).



Redondo Steam Station relies on American Blower HS Fans to efficiently supply and exhaust air throughout the entire building.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN • CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO

Division of American Radiator & Standard Sanitary Corporation

**AMERICAN BLOWER**

**WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS**

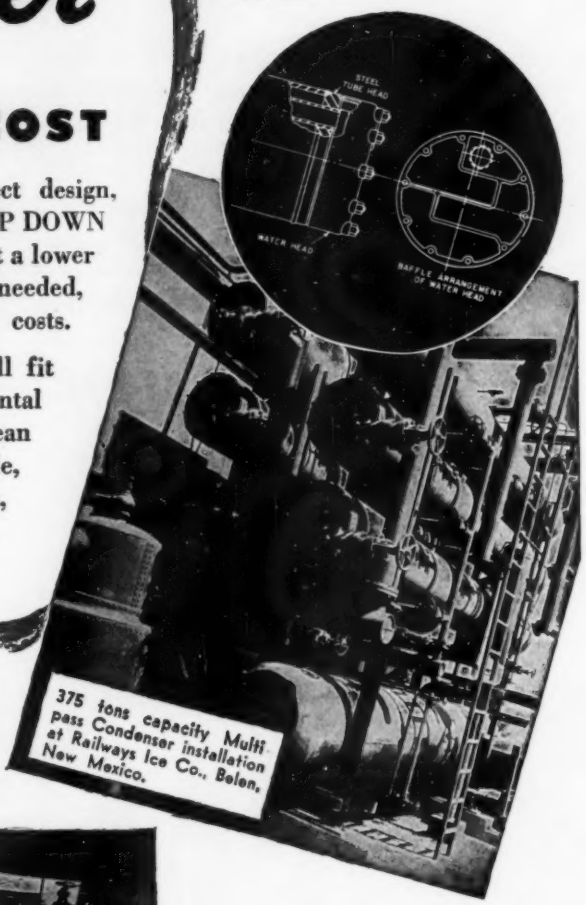
# $ave Power and REFRIGERATION COST

Vogt Condensers, because of their correct design, STEP UP the rate of heat transfer and STEP DOWN head pressures. With the liquid delivered at a lower temperature, smaller compressor capacity is needed, saving in original as well as operating costs.

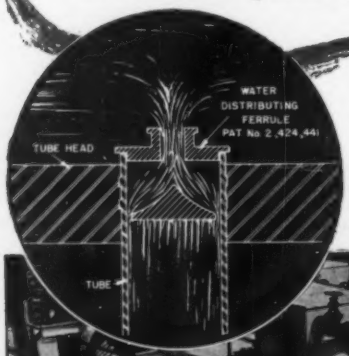
One of the two basic types illustrated will fit your operations exactly. Install Horizontal Multipass (closed type) for use with clean waters. Where the water is hard, forms scale, contains mud or promotes fungus growth, Vertical Single Pass (film type) which can be cleaned in operation, are recommended.

**Horizontal Multipass Condensers**
(Closed Type)

Water circulated in tubes traverses the length of the unit a number of times as determined by baffles in the heads.

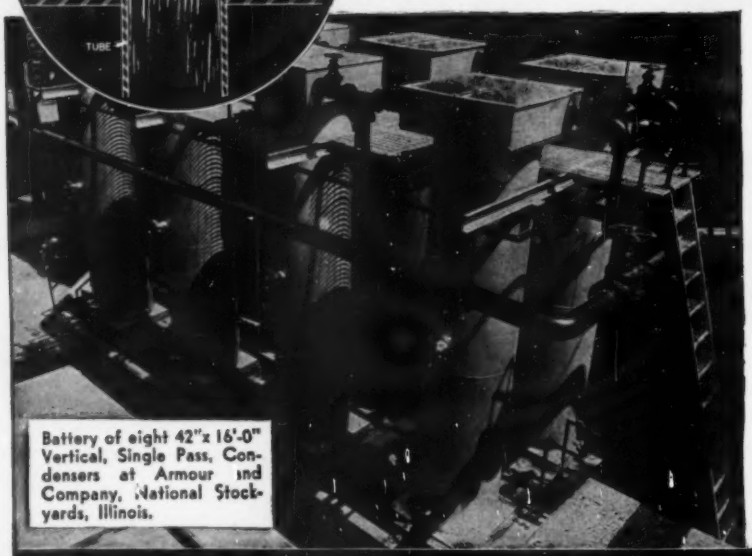



375 tons capacity Multipass Condenser installation at Railways Ice Co., Belen, New Mexico.




**Vertical Single Pass Condensers**
(Film Type)

Patented ferrules give equal distribution of water to and over the surfaces of all tubes in a unit.



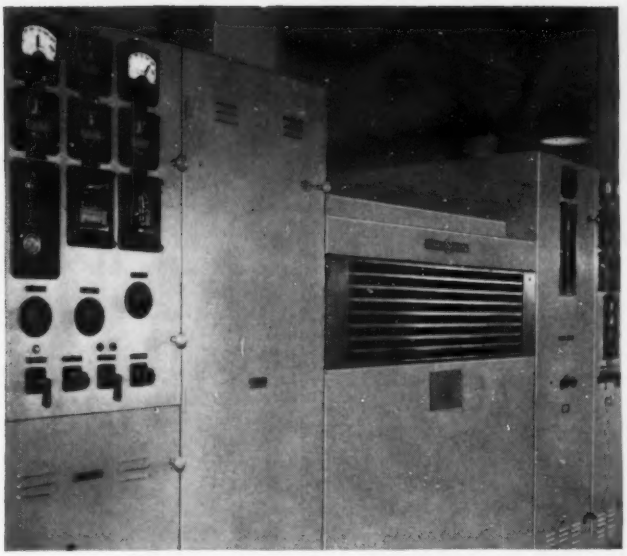
Battery of eight 42"x 16'-0" Vertical, Single Pass, Condensers at Armour and Company, National Stockyards, Illinois.

## HORIZONTAL and VERTICAL TYPES SHELL and TUBE CONDENSERS For Every Service

*Write For Bulletin RC-2*

**HENRY VOGT MACHINE COMPANY**
INCORPORATED
1000 W. ORMSBY ST., LOUISVILLE 10, KY., U.S.A.
Branch Offices: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.

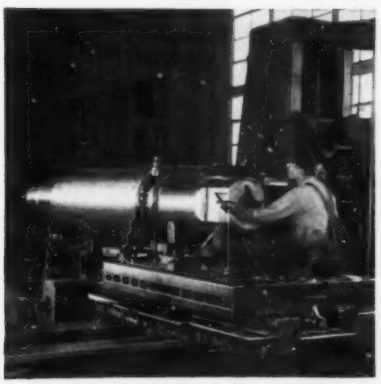
**Vogt REFRIGERATION CONDENSERS**



**D-C UNIT SUBSTATION** has G-E open-ventilated dry-type transformer with rectifier section. Located in power house near main foundry at Roll and Machine Works Division, U. S. Steel.

**G-E MERCURY-ARC** rectifier section converts the 4160-volt a-c power, purchased by the plant in Canton, Ohio, from the Ohio Power Company, to d-c power.

# G-E Ignitron Power Rectifier operates 24 hours a day, 7 days a week for 3 years



**AT U. S. STEEL FOUNDRY**—one of the giant machine tools operated on d-c power provided by G-E rectifiers.

## Roll and Machine Works Division of U. S. Steel has not changed a tube in 3 years

More efficient, safer, *reliable* conversion to d-c power with G-E mercury-arc power rectifiers—that has been the experience of this Canton, Ohio, division of United States Steel Corporation.

The foundry, which makes iron rolls for the parent company, has not had to change a tube in three years of operation. In 1950, the plant switched from 3 steam-driven reciprocating machines to rectifiers. This changeover has saved the company considerable expense, since G-E ignitron rectifiers require a minimum of maintenance as there are no major moving parts to require replacement.

For details on how G-E mercury-arc rectifiers can help with your d-c power needs, call your nearest G-E sales office. General Electric Company, Schenectady 5, New York.

883-3

*You can put your confidence in—*

**GENERAL ELECTRIC**

*For expansion or replacement*

# you get a better buy

with the

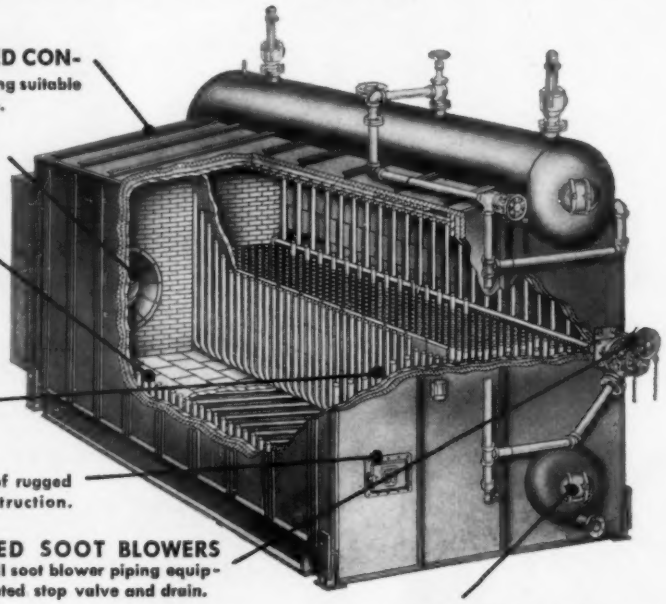
# FW PACKAGE STEAM GENERATOR

If you are planning a new plant, expanding production or want greater efficiency through replacement of your present steam generator, it will pay you to "look into" the Foster Wheeler Package Steam Generator.

For process steam, heating, or "on-the-spot" construction steam, these highly efficient, plant-assembled, water-tube steam generators produce savings in installation, operation and maintenance. They are available in capacities from 7,500 to 35,000 lb of steam per hr. Design pressures are 250, 525 or 825 psi. Multiple-unit installations are practical and economical up to 150,000 lb per hr.

• • •

For low-cost steam "where you need it—when you need it", you get a better buy with the Foster Wheeler Package Steam Generator. For more detailed information, write to Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.



**ALL STEEL WELDED CONSTRUCTION** of casing suitable for outdoor installation.

**TWO BURNERS** on units over 20,000 lb per hr. All burner registers are hinged to permit easy access to diffuser and register louvers.

**FURNACE WATER WALLS** backed with 2" first quality fire clay tile, 2" block insulation and 2½" rock wool blanket.

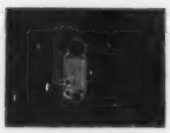
**REAR FURNACE WALLS** are water cooled for full height of furnace, tie in to boiler circulation without use of headers.

**HINGED ACCESS DOORS** of rugged refractory lined cast iron construction.

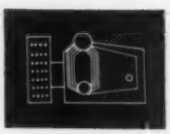
**DOUBLE - ENDED SOOT BLOWERS** on the larger units. All soot blower piping equipped with chain operated stop valve and drain.

**MANHOLES** at both ends of each drum for capacities in excess of 15,000 lb per hr.

## FEATURES THAT DISTINGUISH FOSTER WHEELER PACKAGE STEAM GENERATORS

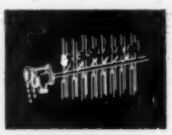


**HIGH STEAM TEMPERATURES.** Provisions for superheaters in some designs.



**ECONOMIZERS.** For larger capacity installations, package economizers can be supplied to provide minimum fuel costs.

**ACCESSIBILITY.** For inspection, cleaning, maintenance.



**CLEAN HEATING SURFACES.** Soot blowers incorporated . . . cleaning without boiler shutdown.

**HEAT LOSS MINIMIZED.** Minimum heat loss — from radiation and air infiltration.

**RAPID LOAD SWINGS.** Large diameter drums and ample furnace heating surface.

FOSTER WHEELER

**SOLID ALUMINUM for End Rings on Very High Temperatures.**

Style 861 Ring and Spiral is composed of a soft annealed aluminum foil folded, crimped and formed into uniform packing section. As end rings it is used on very high temperatures and in combination with other style metallic packings.

**SOLID ALUMINUM with Dry Asbestos Core . . . on Hot Oil Pumps.**

This is Style 862 Ring and Spiral packing, employing a high grade asbestos core over which is formed the twisted, crimped aluminum foil. The asbestos core produces a soft, yieldable packing for use on high speed, hot oil pumps operating in modern oil refinery processes among high temperatures.

**SOLID ALUMINUM with Lubricated Asbestos Core . . . Where Temperatures Exceed 650°F.**

Style 863 (not illustrated) Ring and Spiral employs a high grade asbestos core, lubricated and graphited to be easily yieldable. Highly effective for temperatures over 650°F.

**TWISTED STRANDS over Asbestos Cord . . . on Oil Pumps and Valve Stems Where Temperatures Exceed 500°F.**

Style 864 Ring and Spiral is highly flexible, composed of multiple strands of lubricated asbestos yarns, each strand surrounded by an aluminum foil jacket. Style 864 is used on high speed hot oil pumps, high temperature valve stems, and on hardened valve stems and high speed boiler feed pumps.

**HIGH TEMPERATURES DO NOT AFFECT THESE ANCHOR ALUMINUM PACKINGS!**

**DISTRICT OFFICES**

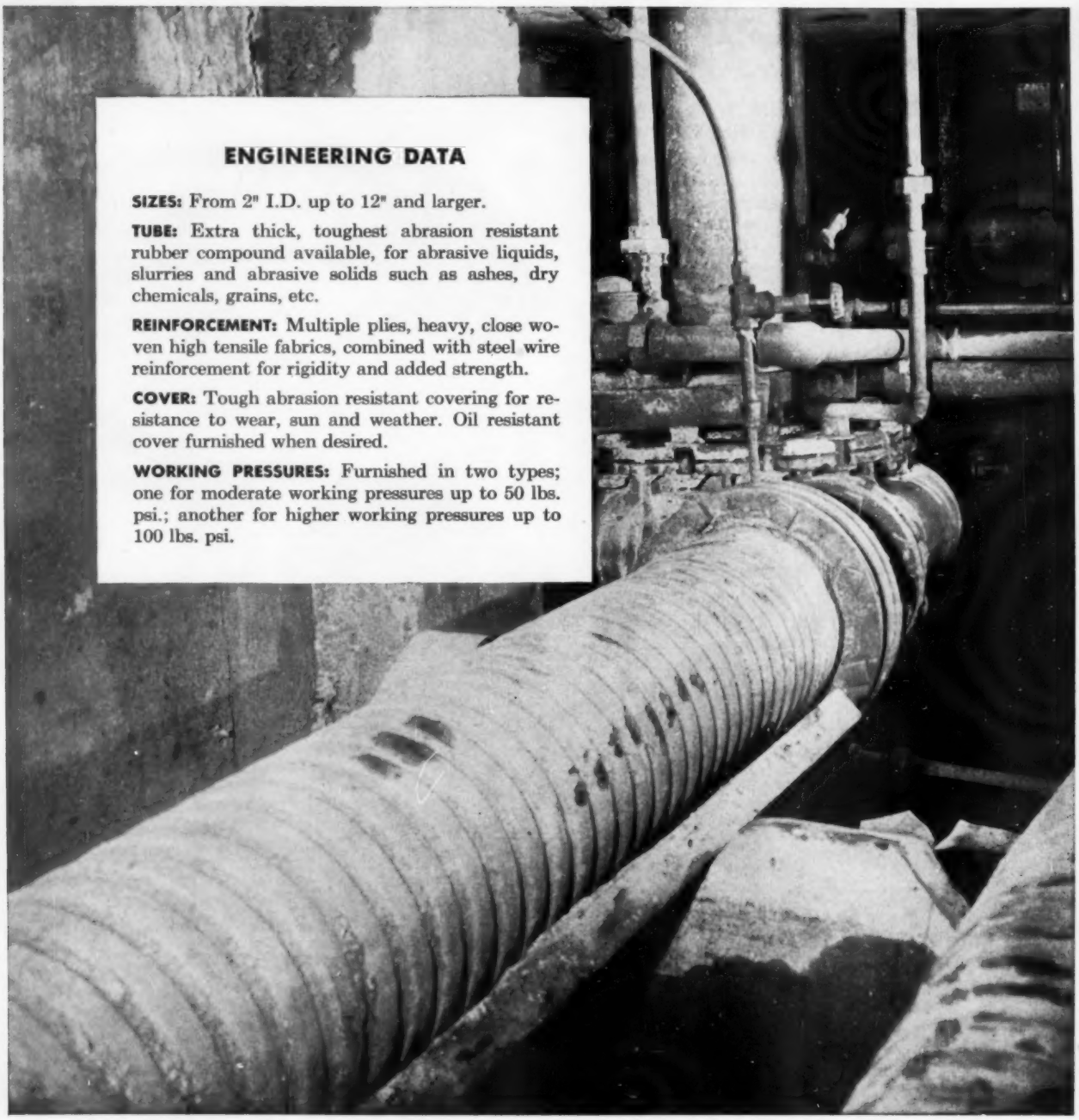
BALTIMORE, MD.
BOSTON, MASS.
BUFFALO, N. Y.
CINCINNATI, OHIO
CHICAGO, ILL.
CLEVELAND, OHIO
DAYTON, OHIO
DETROIT, MICH.
HOUSTON, TEX.
INDIANAPOLIS, IND.
LOS ANGELES, CAL.
MILWAUKEE, WIS.
MONTREAL, CANADA
NEW ORLEANS, LA.
NEW YORK, N. Y.
PHILADELPHIA, PA.
PITTSBURGH, PA.
SAN FRANCISCO, CAL.
SEATTLE, WASH.
SPOKANE, WASH.
ST. LOUIS, MO.
TOLEDO, OHIO
WILMINGTON, CAL.

# THE ANCHOR PACKING COMPANY

GENERAL OFFICES: PHILADELPHIA, PA.
FACTORIES: MANHEIM, PA. ELKHART, IND. MONTREAL, CAN.

**FIBROUS AND METALLIC PACKINGS FOR EVERY INDUSTRIAL PURPOSE**

# Forecasts 5-Year Life



### ENGINEERING DATA

**SIZES:** From 2" I.D. up to 12" and larger.

**TUBE:** Extra thick, toughest abrasion resistant rubber compound available, for abrasive liquids, slurries and abrasive solids such as ashes, dry chemicals, grains, etc.

**REINFORCEMENT:** Multiple plies, heavy, close woven high tensile fabrics, combined with steel wire reinforcement for rigidity and added strength.

**COVER:** Tough abrasion resistant covering for resistance to wear, sun and weather. Oil resistant cover furnished when desired.

**WORKING PRESSURES:** Furnished in two types; one for moderate working pressures up to 50 lbs. psi.; another for higher working pressures up to 100 lbs. psi.

**HEWITT-ROBINS**

**EXECUTIVE OFFICES, STAMFORD, CONNECTICUT**

# in Slag Disposal Line

## Customer's Performance Record

**EQUIPMENT:** Hewitt-Robins Flexible Rubber Pipe.

**LOCATION:** Philadelphia Electric Company, Richmond Generating Station, Philadelphia, Pennsylvania.

**OPERATION:** Disposal of slag and pyrites from two boilers in generating plant.

**PERFORMANCE:** The projected life of a test length of Flexible Rubber Pipe, originally installed in a line handling fly ash, was 8 to 10 years on straight runs and 5 to 6 years on bends—*double the life* of metal pipe in the same line.

Since the test length was installed the line has been changed considerably. It now handles highly abrasive pyrites and slag instead of fly ash, although the volume is the same. Based upon 3 years performance, the projected life of this new line, consisting entirely of Hewitt-Robins Flexible Rubber Pipe, is at least 5 years—a remarkable life expectancy, considering the extremely abrasive material being handled.

**RESULTS:** Hewitt-Robins Flexible Rubber Pipe is replacing existing metal pipe installations for this operation at other stations in the Philadelphia Electric Company.

*Here is a partial list of*

**HEWITT-ROBINS PRODUCTS**

***that will help you cut handling costs and increase operating efficiency.***

**MACHINERY**

Belt Conveyors
Belt & Bucket Elevators
Car Shakeouts
Conveyor Idlers
Dewaterizers
Mechanical Feeders
Foundry Shakeouts
Mine Conveyors
Reclaiming Systems
Screen Cloth
Stackers & Trippers
Vibrating Conveyors & Screens

**INDUSTRIAL RUBBER PRODUCTS**

BELTING:

Conveyor
Elevator
Transmission

HOSE:

Acid
Air & Air Drill
Barge Loading
Dust Suction
Fire
Fuel Oil & Gasoline
Gasoline Pump
Mud Pump Suction
Oil Suction & Discharge
Propane-Butane
Road Builders'
Rotary Drilling
Sand Blast
Sand Suction
Sea Loading
Servall®, All-Service
Steam
Tank Car & Tank Truck
Vacuum & Air Brake
Water & Water Suction
Welding, Twin-Weld®

•

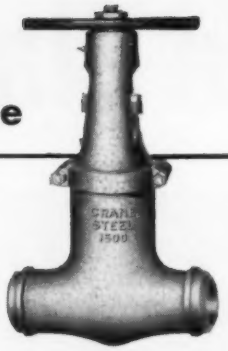
***For information and service on industrial rubber products, contact your Hewitt-Robins Industrial Supply Distributor. Through his complete stock of Hewitt-Robins Rubber products, and his familiarity with local field conditions, he can fill your supply needs promptly and correctly. See Classified Phone Book for the Hewitt-Robins Industrial Supply Distributor serving your area.***

770

**INCORPORATED**

**DOMESTIC DIVISIONS:** Hewitt Rubber • Robins Conveyors • Robins Engineers • Restfoam
**FOREIGN SUBSIDIARIES:** Hewitt-Robins (Canada) Ltd., Montreal • Hewitt-Robins Internationale, Paris, France • Robins Conveyors (S. A.) Ltd., Johannesburg • **EXPORT DEPARTMENT:** New York City.

**for high-pressure high-temperature service**



*here's what you get in*

# CRANE PRESSURE-SEAL BONNET VALVES

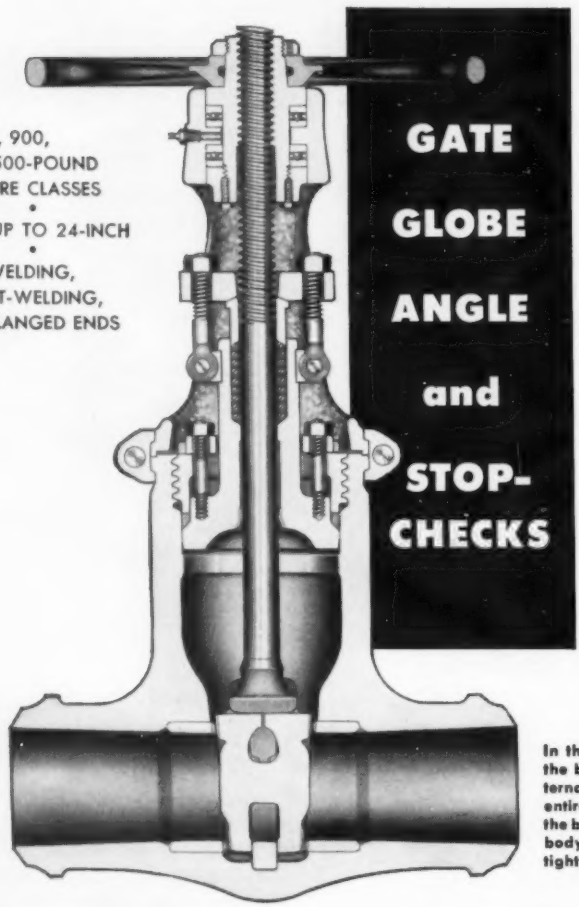
IN 600, 900, AND 1500-POUND PRESSURE CLASSES

•

SIZES UP TO 24-INCH

•

BUTT-WELDING, SOCKET-WELDING, AND FLANGED ENDS



**GATE**
**GLOBE**
**ANGLE**
**and**
**STOP-CHECKS**

**NO BONNET-JOINT LEAKAGE**
. . . and therefore no bonnet-joint maintenance. Crane design utilizes internal fluid pressure to form a pressure-tight metal-to-metal joint.

**SAVINGS IN WEIGHT AND SPACE**
. . . up to 60% over conventional valves. Crane streamlined valve shape also minimizes service strains and stresses. Handling in erection and maintenance is easier. You can save on piping suspension, too.

**STRAIGHT-THROUGH FLOW**
. . . in gate valves, resistance to flow is minimized because inner diameter of body seat rings and inside surface of disc guide are in line. Globes and stop-checks also have excellent flow characteristics.

**SMOOTH, EASY OPERATION**
. . . for instance, in larger size gate valves, a flexible wedge disc prevents sticking . . . is not "pinched" in the valve body by contraction as the result of cooling . . . requires minimum torque to open.

**CRANE QUALITY THROUGHOUT**
. . . depending on service requirements, bonnet and body are Crane Carbon-Molybdenum or Chrome-Molybdenum Alloy Steels. All seating surfaces are long-lasting Stellite. Body seat rings are accurately fitted and welded, and cannot loosen in service.

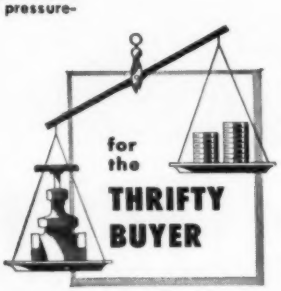
***Get better acquainted with this modern Crane line—ask your Crane Representative for a copy of folder AD1936, or write direct.***

**In the cross-section you can see how the bonnet-joint is *inside* the valve. Internal fluid pressure, acting upon the entire underside of the bonnet, forces the bonnet against the seal ring between body and bonnet, forming a pressure-tight metal-to-metal joint.**

*THE BETTER QUALITY . . . BIGGER VALUE LINE . . . IN BRASS, STEEL, IRON*

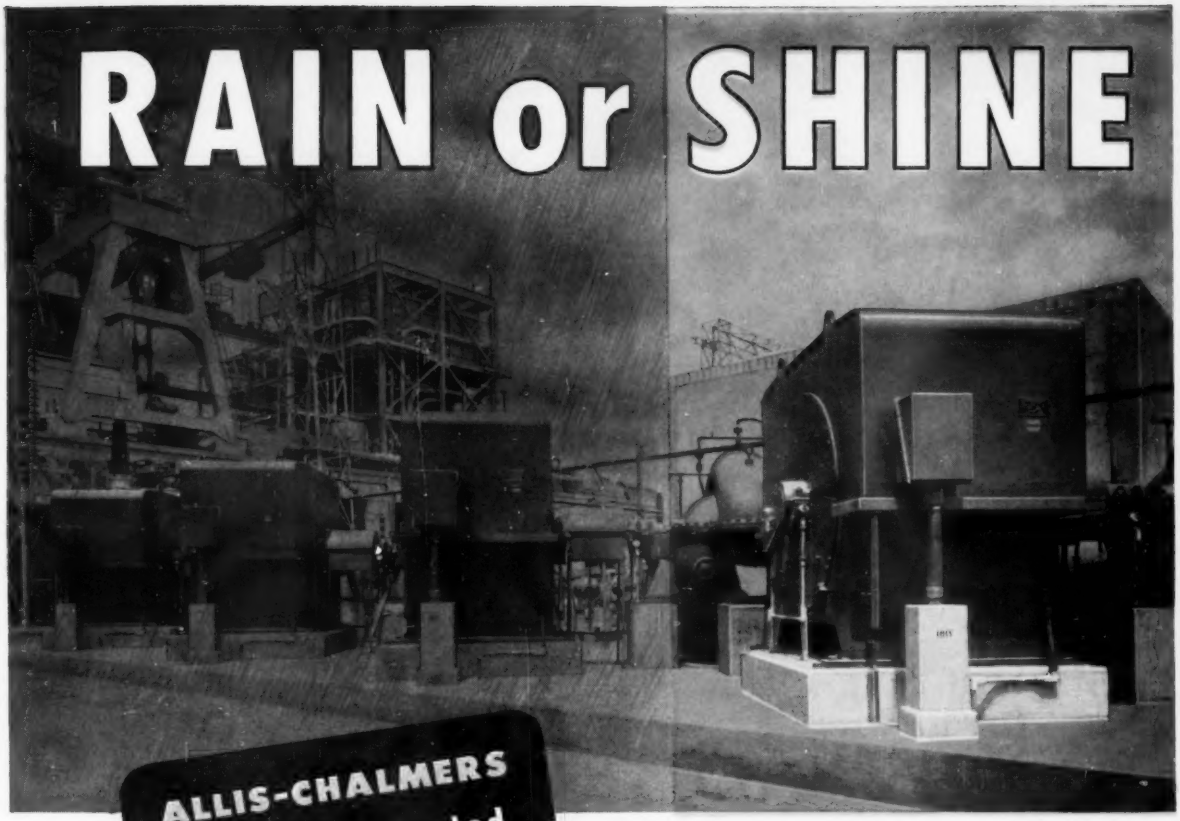
# CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
*Branches and Wholesalers Serving All Industrial Areas*




***VALVES • FITTINGS • PIPE • PLUMBING • HEATING***

# RAIN or SHINE



**ALLIS-CHALMERS**
**Weather-Protected MOTORS**

**Low-cost outdoor installation plus dependable operation under all weather conditions**

**Economy plus reliability** — regardless of weather conditions — was the combination demanded by Southern California Edison for the circulating water pump motors at the 250,000-kw Etiwanda Steam Station. And that's the combination delivered by the four Allis-Chalmers motors shown above.

Each of these modern weather-protected squirrel-cage motors is rated 900 hp, 4160 volts, 435 rpm. Smaller motors of similar design were supplied by A-C for the station's condensate booster pumps.

**Proved by Special Tests**

The weather-protected design has been tested under extreme conditions. Running at normal speed and voltage, motors of this type were deluged with water at rates up to 40 inches per hour — driven by winds up to 75 miles per hour. This was done repeatedly from all angles, but on inspection no moisture was detected on the windings. And other tests checked effectiveness in keeping out wind-driven fine sand — a serious threat at this west coast installation.

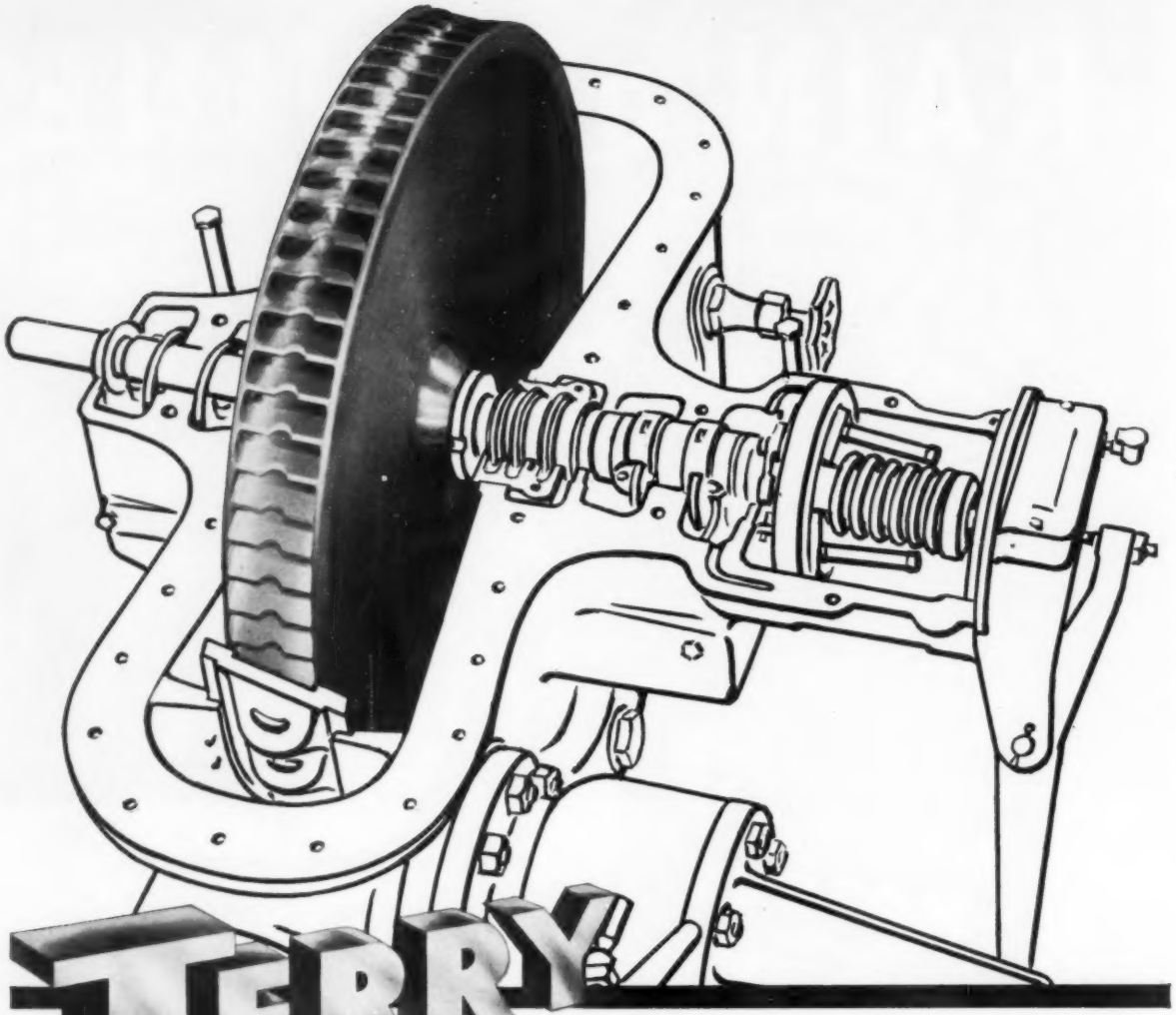
**Movie and Bulletin Available**

See how A-C test-proved these motors. Ask your A-C representative to show you the 12-minute movie *The Sky is the Roof*. Or write for Bulletin 05B7874. Allis-Chalmers, Milwaukee 1, Wisconsin.

A-4176

**ALLIS-CHALMERS**

A-C ALLIS-CHALMERS




# SOLID WHEEL RUGGEDNESS

## is your turbine dividend

The rugged construction and fool-proof design of a Terry solid-wheel turbine can save you money by keeping maintenance costs to a minimum. Usually only taken down for routine inspection, any repairs that must be made are of relatively simple nature, and cost of replacement parts is small.

The rotor of the turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

It is impossible for the blades to foul. They have large clearances and are further protected by the projecting rims of the sides of the wheel. As the side clearances are also very large, end play can do no harm.

The Terry solid-wheel turbine is an extremely reliable piece of equipment—why not write for complete details today? Ask for a copy of Bulletin S-116.

**THE TERRY STEAM TURBINE COMPANY**
**TERRY SQUARE, HARTFORD 1, CONN.**

TT-1198

# The President Urges World-Wide Atomic Power

IN HIS HISTORIC SPEECH on atomic energy, delivered to the UN General Assembly on December 8, 1953, President Eisenhower urged accelerated world-wide development of atomic power, under UN auspices, as a major step toward easing the world tensions caused by atomic weapons. Thus the Chief Executive of the United States tells power engineers everywhere that they can help the world avoid the horrors of atomic war.

Most POWER readers have read the President's message in the daily press or heard it on TV or radio, but the high spots deserve a quick review:

The latest model A-bombs, Mr Eisenhower revealed, are twenty-five times as powerful as those that dealt the death blow to Japan. A single modern A-bomb equals 1 billion pounds of TNT, and a single hydrogen weapon is rated in millions of tons of TNT.

Our total atomic stockpile, he reported, exceeds by many times the TNT equivalent of all the shells and bombs exploded in all the theaters of war throughout World War II. He reminded us that the bomb "secret" is already possessed by Great Britain, Canada and Russia, as well as the United States. Some day bomb knowledge will be the common property of all nations.

The President also reminded us that America's present great numerical superiority in atomic weapons, plus all our costly and growing defenses, cannot keep us safe from atomic attack. There is no complete defense; in any atomic war, both sides will get through with many bombs, and both sides will be desolated. Even the winner must surely "lose" such a war.

Speaking to all nations through the UN Forum, the President pleaded for peace, asked the world to move out of the "dark chambers of atomic horrors" into the light of peaceful applications. He announced his willingness to confer with Russia at any time and to work sincerely for some tangible progress toward peace. He said that the U.S. wishes to meet as soon as possible with representatives of other interested nations, in a committee organized and directed by the United Nations, to seek an acceptable solution of the atomic problem.

The President proposed that the governments principally involved begin now to make joint contributions from their stockpiles of uranium and fissionable materials to an international atomic agency under the UN. This would make a start in atomic teamwork without tangling with the earlier controversial proposal of world-wide inspection.

The UN Agency would allocate its fissionable material to serve the peaceful pursuits of mankind. Experts would be mobilized to apply atomic energy to meet the needs of agriculture, medicine and other pursuits.

A special purpose would be to supply abundant electrical power to the power-starved communities of the world. This last, he made clear, was a major part of his plan. "The United States knows that peaceful power from atomic energy is no dream of the future. That capability has already been proved, is here now. Who can doubt, if the entire body of the world's scientists and engineers had adequate amounts of fissionable materials with which to test and develop their ideas, that this capability would rapidly be transformed into universal, efficient and economic usage?"

President Eisenhower clearly feels that the world-wide encouragement of atomic-power development is an essential first step toward the distant goal of atomic peace. In itself, building atomic-power plants will certainly not end the making of bombs, yet it may be the one thing that will catch the imagination of the world and get the nations working together constructively on atomic problems.

We Americans must not view this proposal merely in the light of our own vast fuel resources and low power costs. The effect on "power-starved" countries may well be the major consideration.

One thing is sure: Atomic power has been given a big boost by the President's speech. And power engineers throughout the world have been presented with a great new obligation and opportunity.

**Commander Mills, Inc., Sand Springs, Oklahoma**

***Chief Electrician, Wm. Bert Peacock, Speaking . . .***

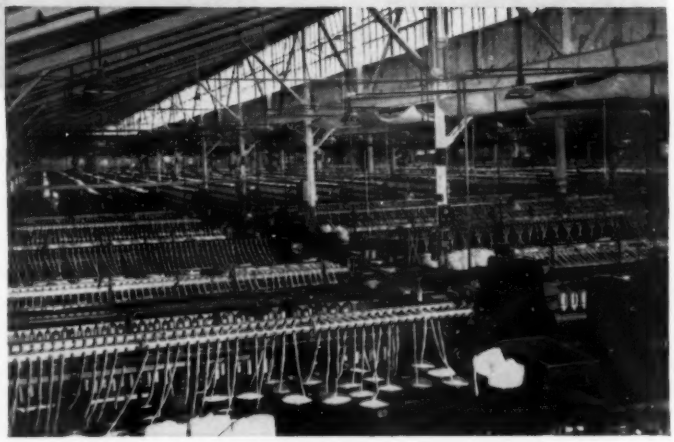
## "Protecting motors with FUSETRON fuses is saving us about $6000.00 per year."

"We have a thousand looms, 90 of which are powered by 1 hp motors, 180 by 1½ hp, 100 by ½ hp, 630 by ¾ hp. Prior to 1949 several hundred of these were rewound each year. In fact, they carried them out by the truck loads to the motor rewind shop.

We started using Fusetron Fuses in the winter of 1949 and began to keep individual records on motors. The reduction on motor burn-outs was immediately noticeable. In 1950 only 44 loom motors were repaired.

There is no way to know how much damage was done to motors prior to our new system of maintenance, and it is my belief that some motor repairs now are due to partial damage done prior to 1949.

"In the entire plant we have over 2,500 motors, representing a little more than 5,000 hp connected load. The following list shows our actual expenses on motor repairs:"



| "YEAR OF REPAIRS | NUMBER OF MOTORS | AMOUNT |
|---|---|---|
| 1949 | (No Record Kept) | $6,804.00 |
| 1950 | 87 | 2,796.20 |
| 1951 | 59 | 2,640.44 |
| 1952 | 63 | 2,165.63 |
| 1953 (1st 6 mos.) | 23 | 445.84 |

| | NUMBER OF MOTORS | DATE OF REPAIRS | AMOUNT |
|---|---|---|---|
| BREAKDOWN OF RECORD FOR MOTOR REPAIRS FOR PAST 6 MONTHS: | 3 | JAN. | $ 76.37 |
| | 4 | FEB. | 88.62 |
| | 3 | MAR. | 70.62 |
| | 4 | APRIL | 87.75 |
| | 4 | MAY | 101.86 |
| | 2 | JUNE | 20.62 |
| | | | $445.84" |

**Commander Mills, Inc., Sand Springs, Okla.**
**Superintendent W. R. Swafford, *in charge of Manufacturing, says:***

# "WE AVOID UNNECESSARY SHUTDOWNS AND PREVENT MOTOR BURNOUTS BY USING FUSETRON FUSES"

"In the sewing room we have 70 machines using ½ hp, 3-phase motors.

"They are all equipped with Fusetron fuses rated at 3.2 amperes. Formerly, we used 30 ampere fuses to avoid unnecessary blowing on the starting surges of the machines.

"The Electrical Department installed these smaller Fusetron fuses several years ago, and we have not had any trouble with blowing them needlessly and neither have we had any motor burnouts.

"We believe it better to blow a fuse than burn out a motor!"

**You too, can profit by the 10 POINT PROTECTION of FUSETRON dual-element FUSES**

1. *Protect against short-circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

*Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York City in December 1947.

**FOR MORE INFORMATION** *use this Coupon* ➡

FUSETRON is a trademark of the Bussmann Mfg. Co., Division of McGraw Electric Co.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

BUSSMANN Mfg. Co. (Division of McGraw Electric Co.)
University at Jefferson, St. Louis 7, Mo.

Please send me complete facts about FUSETRON dual-element Fuses.

*Name*_____

*Title*_____

*Company*_____

*Address*_____

*City & Zone*_____ *State*_____ 154

# WHICH WILL IT BE . . .

## a little more NOW—or a lot more LATER?

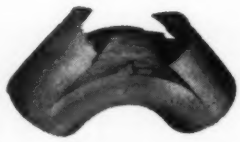
Let's take a close look at this so-called higher cost of wrought iron pipe.

All too often, INITIAL COSTS are used as the only basis of comparison. The fallacy of the initial-cost-yardstick has been proved time and time again in installations where low-first-cost piping has been installed and has failed prematurely. The original installation was quickly made by pipe fitters. But repairs call for hours of work by as many as five craftsmen—pipe fitters, masons, carpenters, plasterers, painters. And labor costs are only part of the picture. The indirect costs of production slowdowns and disrupted routine swell the total of every premature pipe failure. It's easy to see how this first failure can wipe out initial "savings" many times over.

The only *valid comparison* of piping costs is INSTALLED COSTS *plus* REPAIRS. This yardstick places the emphasis where it rightly belongs . . . on SERVICE LIFE. In installation after installation, wrought iron pipe has doubled, tripled and even quadrupled the useful service life previously obtained from low-first-cost piping. All this adds up to one thing . . . the fact that you pay a little more for wrought iron means that you pay a LOT LESS FOR MAINTENANCE. Wrought iron gives you *piping economy,* because it lasts longer, at lower cost per year!

If you are concerned about piping services where corrosion is a threat to durability, you'll find it profitable to investigate the longer life of wrought iron pipe. Our Engineering Service Department will be happy to send you examples of typical wrought iron service records in installations similar to those in which you are interested. Write or call.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Department: New York, N.Y.



### Why Genuine Wrought Iron Lasts

This notch-fracture test specimen illustrates the unique fibrous structure of wrought iron—which is responsible for the high corrosion resistance of the material. Tiny threads of glasslike silicate slag, distributed through the body of high-purity iron, halt and disperse corrosive attack, and discourage pitting and penetration. They also anchor the initial protective scale, which shields the underlying metal.

# BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

**WROUGHT IRON**

**TUBULAR AND HOT ROLLED PRODUCTS**

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

Power
FEBRUARY 1954

# NOW! 97% efficiency with the...
# Mechanical Rectifier

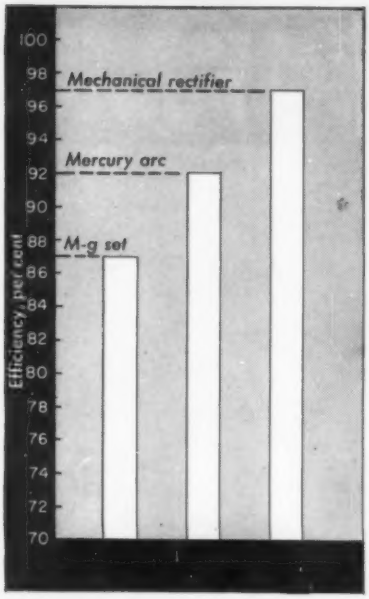
**Big dc power users are eying youthful, foreign-born, mechanical rectifier with its top efficiency, as U.S. engineers fast iron out the growing pains. Here is *Power's* timely report on recent design changes, operating experience, and a look to the future**

## DESIGN

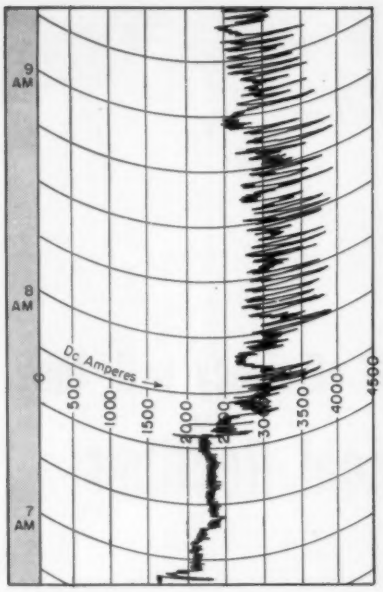
Brought to this country after World War II by I-T-E's Otto Jensen, mechanical rectifier has seen scattered installations mainly in electrochemical plants. But German-born contact-converter is fast reaching out to other fields. I-T-E is ready to tackle tough transit loads, aluminum-ore reduction, dc arc furnaces. Jensen no longer sees 400 v as top operating limit; this has been upped to 1000 v. Design changes are fast licking the contact-life problem. General Electric has entered the field with units rated 12,000 amp at 250 v; 6000 amp at 250-400 v.

## OPERATION

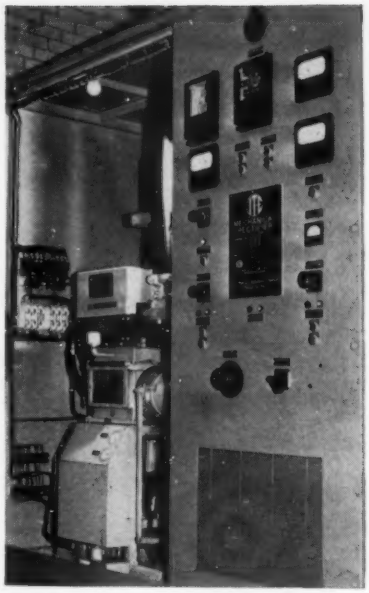
For the operating slant, POWER visited smallish Fields Point Mfg Corp after they had lived with two 420-kw mechanical rectifiers almost two years. This Providence, R. I. chemical manufacturer (chlorine and caustic) mastered the few new operating and maintenance tricks, came out with 97% average efficiency. To youthful manager J C Hadfield efficiency is mighty important since company's main raw materials are salt, electric power. He sees fewer maintenance and operating headaches with these newer rectifier units, compared to the old m-g sets. **Turn Page**




**EFFICIENCY** of mechanical rectifier, figured between ac and dc bus, gets biggest dip in power transformer. High-eff angle appeals most to users of rectified high-power. Mechanical unit may not compete with other rectifiers in low-voltage, low-power range since higher eff loses importance




**SWINGING LOAD** can be handled up to 150% of rectifier rating. Above chart of cement-mill motor load shows swings in morning peak. As with mercury units, mechanical rectifier (1) cannot absorb regenerative load (2) has voltage control like phase shift by selection of point on wave



**RECTIFIER** in left compartment has silver contacts, operated through pushrods off a synchronously driven shaft. Latest units use air rather than water for cooling main-contact bus structure and lube oil. Above unit rated 420 kw, 1500 amp, 280 v. Oscilloscope plays important role in maintenance

# Top efficiency, even with varying motor load, is offered

Mechanical conversion of ac to dc has long been an engineering aim, promising top rectifier efficiency. For success, contact between ac and dc lines must be made and broken only at current-zero. Development was stymied till commutating reactor was considered. This proved key to stretching out current-zero points, allowing time for contacts to operate.

**Today's rectifier** has six or 12 contacts (3- or 6-phase unit) operated through mechanical linkage from a motor-driving eccentric shaft. Pushrods open spring-loaded contacts between ac and dc bus bars.

Even with commutating reactor, accurate timing is of top importance. Contacts will be damaged if they (1) close under an appreciable voltage (2) open or close with appreciable current in circuit (3) face a high recovery voltage right after opening.

Contacts fall into two main groups: One makes contact between ac and positive dc bus, the other between the same ac phases and negative dc bus.

Cooling for contact-bus structure has also come in for a change. Forced air, for both bus structure, on which contacts operate, and lube system, has replaced the former watercooling method on I-T-E unit.

**Commutating reactor** has a nickel-iron core that needs but small magnetizing current for complete saturation. Once saturated, the reactor's low impedance is comparable to an air-core unit. The all-important "step" is created when reactor is in series with contact (anode) circuit.

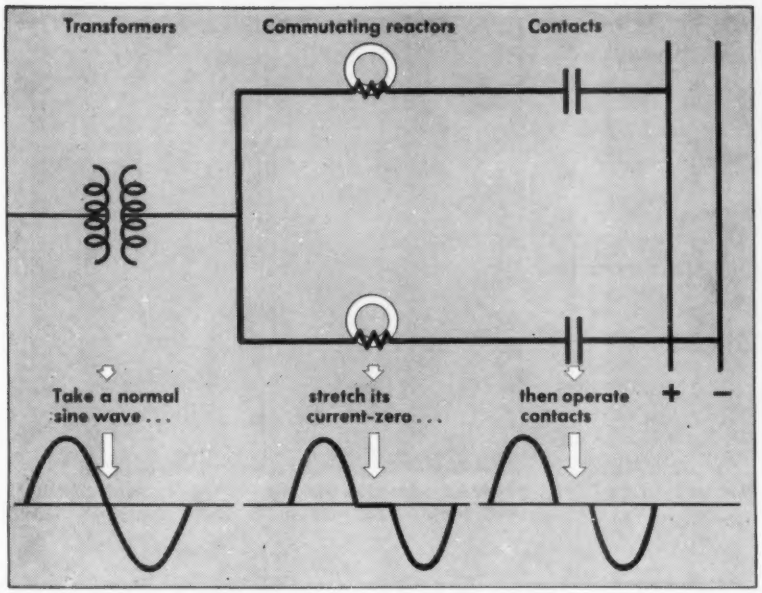
The commutating reactor introduces inductance to each phase that, when added to power-transformer leakage reactance and bus-bar reactance, accounts for the voltage drop inherent in rectifier. It may be compared on a small scale with voltage drop across mercury-arc units. But, in the latter case, drop is constant throughout load range.

One of I-T-E's recent design changes involves the commutating reactor. Now two reactors are used per phase, one for each contact. Doubling the number of reactors meant voltage across contacts can be held closer to zero on contact make. This was one factor that contributed markedly to longer contact life. In addition, adoption of the single-way reactor scheme improved control of dc output voltage.

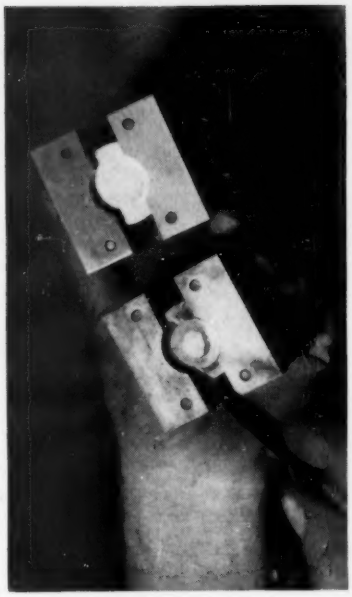
**Mercury-arc** rectifiers will operate over wide range from no-load to high overload. With one exception, this also holds true for the mechanical rectifier. Mechanical unit depends on maintained commutation since it will not functior properly at absolutely no load. To lick this, a small base-load resistor is provided within the rectifier structure for no-load operation.

Mechanical rectifier can well handle a varying load, sketch, *above*. This chart was taken on a dc-motor load fed by a mechanical rectifier at the Whitehall Cement Co in Cementon, Pa. As with mercury-arc units, the mechanical rectifier cannot absorb regenerative load. Here the motor-generator set shines alone.

Adoption of contact guides made a significant contribu-




**COMMUTATING REACTOR** is key to successful operation. Early units with one reactor per set of contacts gave way to dual units. Result: longer contact life plus better dc voltage control. Nickel-iron core reactors need small magnetizing current for saturation. Once saturated, low reactance compares with air-core unit. By inserting reactor in series with load circuit, a low-current step is created when contact current drops to zero. Power transformer to supply 3-phase voltages is standard low-impedance unit connected star or delta. Sole purpose: to supply proper secondary voltage for dc utilization



**MAIN CONTACTS** are designed to carry, but not interrupt, heavy currents. So they must operate only when current wave passes through current-zero. Contact life was relatively short in early units, but recent developments—use of contact guides and one-way reactors—stretched life span

# through a simple commutating reactor and silver contacts

tion to longer contact life. Now contacts always close on the same point, assuring that surface hills and valleys coincide. There was some tendency to weld when contacts were free to reseat at random positions.

**Efficiency figures** for any rectifier should include all equipment between the incoming ac line and dc bus. In the mechanical rectifier that means power transformer, commutating reactor and main contacts.

Probably the latest accurate field-measured efficiency figure for a mechanical rectifier was that included in a paper delivered January 20, 1954 at the AIEE General Winter Meeting in New York. Here the authors (J Chamulak and J W Tracht of Pennsylvania Salt Mfg Co, and W C McCullough of I-T-E) offered an efficiency value of 97% after more than two years' operating experience with a 10,000-amp 267-v unit.

Efficiency calculations were based on readings taken on an induction watthour meter and a dc potentiometer-type watthour meter with mechanical integrator. Data were assembled while rectifier operated at 85% load. Accuracy of both meters was maintained within 0.5%.

**Historically,** a dc generator commutator was the first rectifying device. But the commutator is not generally thought of as a rectifier since it's an integral part of a rotating machine.

Mercury-arc rectifier was the first true rectifier as we know it. Commercial application of the glass-bulb Hg rectifier was made about 1904. Development of metal-tank mercury unit proceeded slowly until 1925 when the pace accelerated. Metal tanks were promoted by the *ignitron* in 1933 and the *excitron* in 1944. By 1940 mercury-arc rectifiers had practically superseded rotating converters for dc voltages over 200 and ratings beyond 1500 kw, except where a wide voltage range was needed. The m-g set still finds many applications where variable dc voltage is a must (see POWER, Oct 1953, p 121).

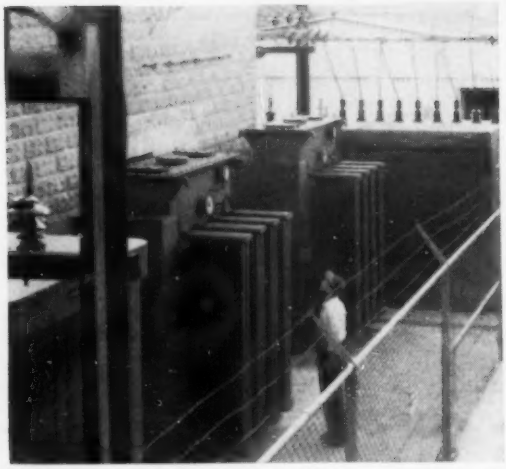
Metallic rectifiers came into being about 1912 when copper-sulfide units were developed. Commercial applications of copper-oxide units started in 1924. Selenium rectifiers, manufactured in Europe since the early 1930s, were introduced in this country about 1939.

In 1935, Siemens Schuckert Co in Germany showed interest in dc high-voltage transmission with mechanical rectifiers. Their first model consisted of a synchronous-driven 2-pole segment-wheel that successively touched three stationary carbor contacts. Even though the contacts were blasted with compressed air, heavy contact-burning was the rule. Through accident, it was found that contacts stood up better without the blast of air. Apparently the air interrupted current prematurely, causing a recovery voltage across contact gap. Development work then moved fast leading to (1) placing a condenser across contacts (2) adopting an impedance in series with contacts. The latter is today's commutating reactor.

By 1940, the first commercial contact-converter (5000 amp, 225-300 v) made its appearance in Germany. By 1945, the German know-how was available in U. S.

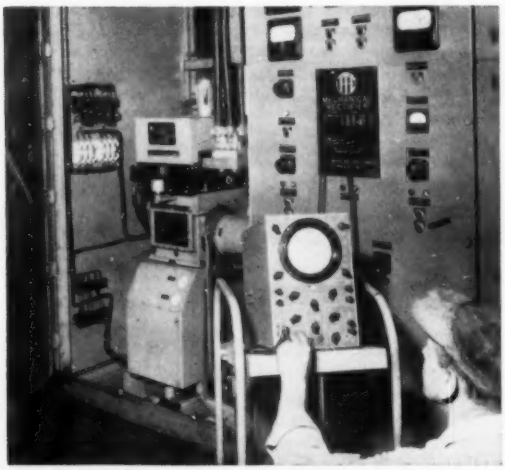
Turn page

**Two 420-kw mechanical converters help boost production...**



**PRIMARY** substation encloses 11-kv utility feed, switchgear, transformers, and pf improving capacitors, *left*

**And men adopt new operating tricks, as...**



**OSCILLOSCOPE** plays important part in preventive maintenance. Daily check determines contact condition

# Electrochemical plant rounds out 22 months of 7-day-week

Fields Point Mfg Corp is a small chemical plant pulling 1250 kva from the Narragansett Light and Power. Its electrochemical cells, operating on a 24-hr 7-day basis, were fed dc from a rotary converter and two double-ended motor-generator sets for 30 odd years. Mechanical rectifiers were adopted because of the promised high efficiency. And to date the company is not disappointed.

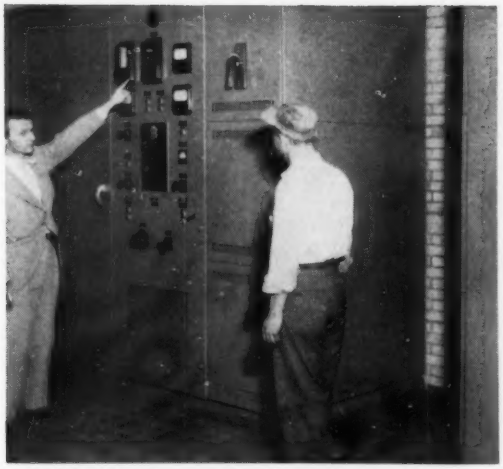
**Installation** is fed from an 11-kv utility line through outdoor switchgear and two 550-kva oil-filled transformers. Capacitor bank, alongside the outdoor gear, ups plant power factor to about 100%.

Separate rectifier room helps isolate rectifier chatter, plus keeping units away from plant dirt. Room is held at a slight positive pressure through a fan and duct arrangement.

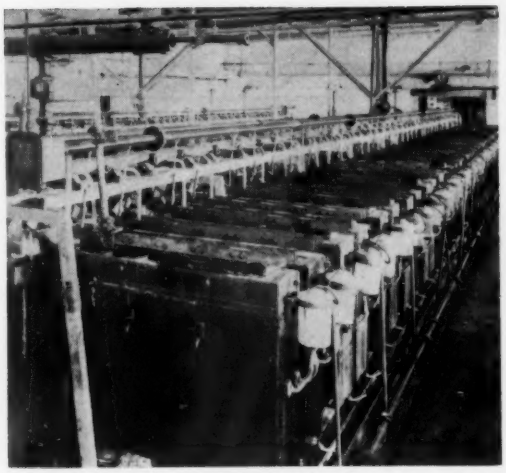
Each of the two 420-kw mechanical rectifiers, rated 1500 amp at 280 v, feeds a separate electrochemical bank. Rectifiers maintain constant current, 1325 amp, automatically.

Operating history is good. When visited by a POWER editor Unit No. 1 had chalked up 12,880 hr, Unit No. 2 had operated 13,332 hr. Power interruptions logged during the operation to date were traced to utility outages, lightning, etc.

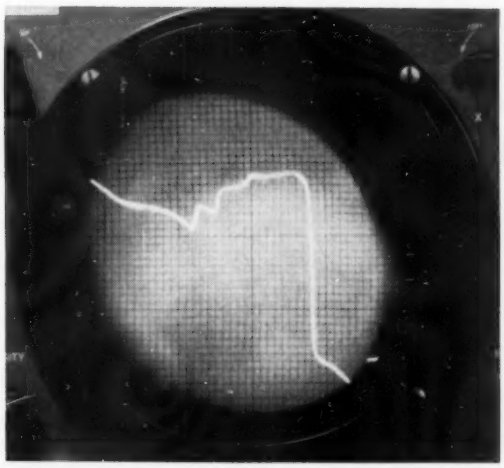
**Average efficiency** agreed upon in this plant is 97%. That



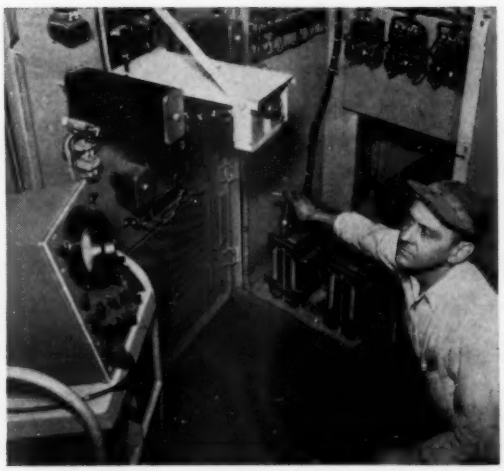
**ANNUNCIATOR** on rectifier panel that targets troubles is pointed out to Electrican Tominski by J C Hadfield



**CELL-ROOM** output upped close to 30% because of high rectifier eff, constant-current dc, greater capacity



**SCOPE TRACE** tells quickly if timing, contact surface are normal. Upper-section break means contact trouble



**ADJUSTMENTS** in contact-timing or excitation circuit are always made with one eye on the oscilloscope trace

# constant current operation with few rectifier troubles

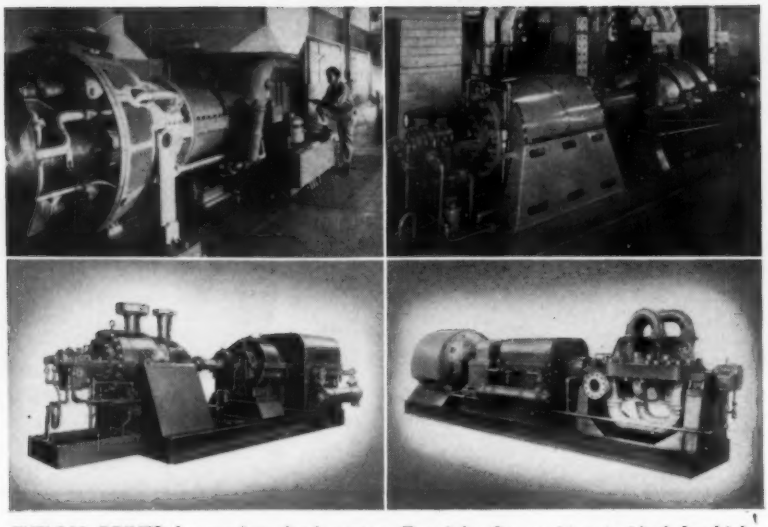
is arrived at by taking incoming kwhr and dividing it into the dc volt-amperes. We can question accuracy of readings since the dc data were taken by operators from switchboard instruments.

During the early months of rectifier operation, contacts were changed frequently. Time has shown that many of these changes were unnecessary. Latest set of contacts are in use over 6000 hr, and an oscilloscope check shows them in good working order.

**Plant electrician,** Henry Tominski, drew an analogy between rectifier contacts and brushes on a motor-generator set. But of the two he felt it easier and faster to replace contacts. Tominski can replace set of contacts in 20 minutes. And that would hold for any plant electrician after a reasonable break-in.

Chief preventive-maintenance "tool" is the oscilloscope that indicates condition of contacts by shape of trace. Marked break in upper portion of trace means contact pitting or arcing. As a routine measure, contacts are blown out occasionally with compressed air.

Present contact-change policy hinges on actual failure rather than the proven wasteful factor, hours of operation.



**TYPICAL DRIVES** for modern feed pumps. *Top left:* Gas turbine is ideal for high-speed pumps. *Right:* Steam turbine direct drive of pump. *Lower left:* Double-casing barrel type with hydraulic coupling and stepup gear. *Right:* Same, but axial split

# Drives for Tomorrow's Superpressure

**For the immediate future, motor drive with a stepup gear is expected. Later, variable-speed, steam- or gas-turbine drive may take over. Variable high-frequency control is discussed**

► LAST MONTH we appraised the trend to higher speeds for centrifugal boiler-feed pumps and the mechanical features that the design of these units should incorporate (Jan, pp 73-78). Now we will speculate on the type of drivers these pumps will require.

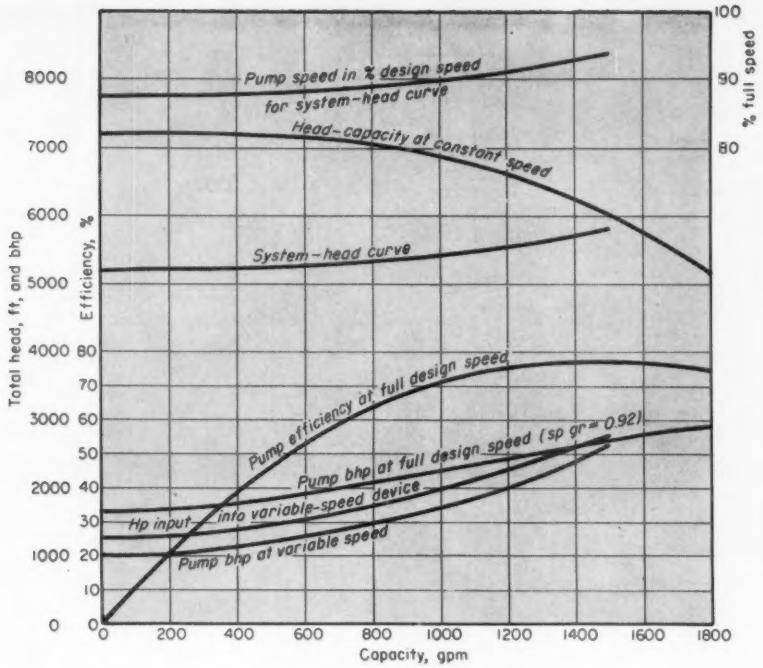
**Stepup Gear Drive.** In the immediate future, most feed pumps will probably continue to be electric-motor driven. As a result, stepup gears will be needed between motor and pump. Since use of gears is contrary to modern power-plant practice, we may expect some initial opposition. Also it will take considerable effort to educate power-plant personnel in the proper evaluation of gear reliability and the logic of their application.

To explain the attitude of U.S. designers toward stepup gears for feed-pump service, let's review some history. In the early days of low-pressure steam plants, feed pumps ran first at 1200 rpm and then at 1800. Either squirrel-cage or wound-rotor motors were used for pump drive. When steam pressures started to increase, designers introduced higher-speed pumps. But for years only steam turbines could drive these units because squirrel-cage motors were not dependable at 3600 rpm.

By 1928, the 3600-rpm squirrel-cage motor had become a dependable unit with horsepower ratings suitable for feed-pump drive. It soon became the standard drive for feed pumps. Meanwhile, operating pressures kept increasing and, by 1936, the obsolete 1800-rpm pumps were no longer manufactured. Because 3600-rpm wound-rotor motors were not available in those days, the savings from variable-speed operation did not receive much consideration. Designers chose to avoid stepup gears needed with wound-rotor motors and applied direct-connected squirrel-cage motors. These were quite satisfactory for the service conditions encountered. Thus, the disfavor with which power-plant designers regarded stepup gears stemmed from the fact that until recently 3600

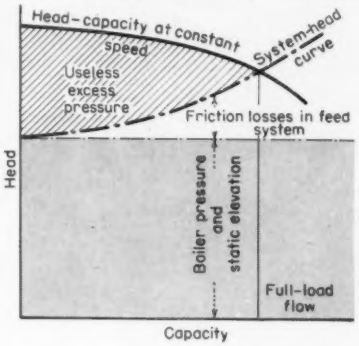
**second in this series**

**by Igor J Karassik** { Manager, Multistage Pump Section, Centrifugal Pump Division, Worthington Corp




**1 PERFORMANCE** at constant, variable speeds of feed pump handling 1500 gpm at 300 F. Total head of 6000 ft

**2 HYDRAULIC** characteristics of typical boiler-feed system, showing useless excess pressure the pump develops




# High-Speed Boiler-Feed Pumps

rpm was considered high enough for boiler-feed service.

**An attempt** to obtain acceptance of stepup gears took place in the late Thirties when the desire to use variable speeds resulted in introducing the hydraulic coupling for boiler-feed service. At that time this equipment was not available for 3600-rpm operation. One installation used an 1800-rpm squirrel-cage motor driving a hydraulic coupling attached to a stepup gear, connected to a 3600-rpm feed pump. Had the manufacturers of hydraulic couplings failed to develop a 3600-rpm unit, there is no doubt that additional geared units would have been installed in the U.S. This, of course, might have led to an earlier adoption of higher speeds since the use of a stepup gear would have eliminated a fixed top speed.

An opportunity for a wider use of stepup gears for feed-pump drive arose shortly after World War II, when a tremendous increase in construction took place in both European and South American steam power plants. Because these plants all generate 50-cps current, maximum speed obtained with direct drive is 2950 rpm. Numerous disadvantages would have accrued from derating standard 3600-rpm pumps to this lower speed.

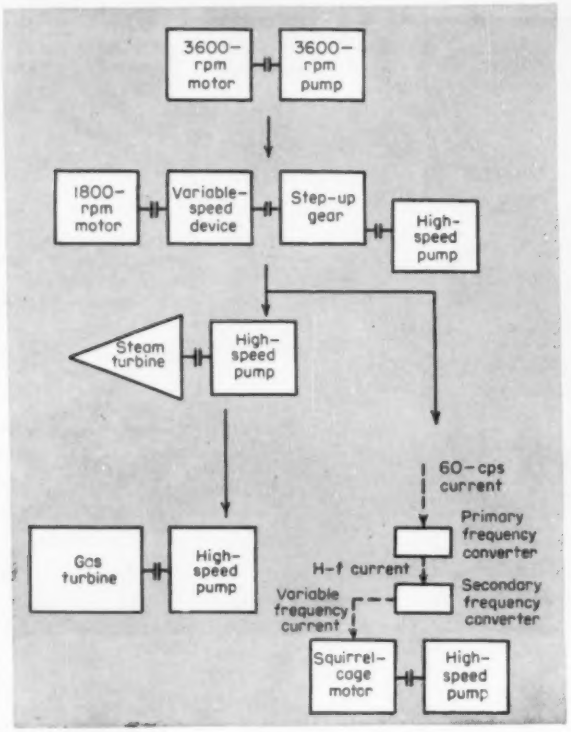
**Fortunately,** as early as 1946, the U.S. made several important installations in Europe using 1450-rpm 4-pole motors and stepup gears. Success with these units played an important part in the ECA power-plant program. All reports received so far indicate that the motor-driven feed pumps ordered for these plants in 1950 and 1951 are *gear driven*. This program represents a total of more than 75 pumps, operating at pressures from 1100 to 1800 psi.

Once stepup gears are accepted for feed service, electric motors may be selected to operate at the speed yielding the most economical over-all combination. At present this means that 1800-rpm motors will be preferred because 4-pole motors are much less expensive than 2-pole 3600-rpm units in the horsepower range needed for feed service. Under these conditions, we may expect that the variable-speed magnetic drive coupled to a squirrel-cage motor will compete with the hydraulic coupling in feed-pump applications.

**Why Variable-Speed?** This type of operation has raised both academic and practical arguments for a number of years. The pressure developed by a centrifugal pump at constant speed increases with a decrease in capacity, the rise in pressure between full-load flow and shutoff conditions ranging anywhere from 10 to 30%. On the other hand, the pressure required for boiler feeding has the general characteristics of a system-head curve, decreasing appreciably with a flow reduction. The difference between the pressure required to feed the boiler and that generated by the pump, Fig. 2, is, therefore, useless and must be absorbed by throttling or eliminated by variable-speed operation.

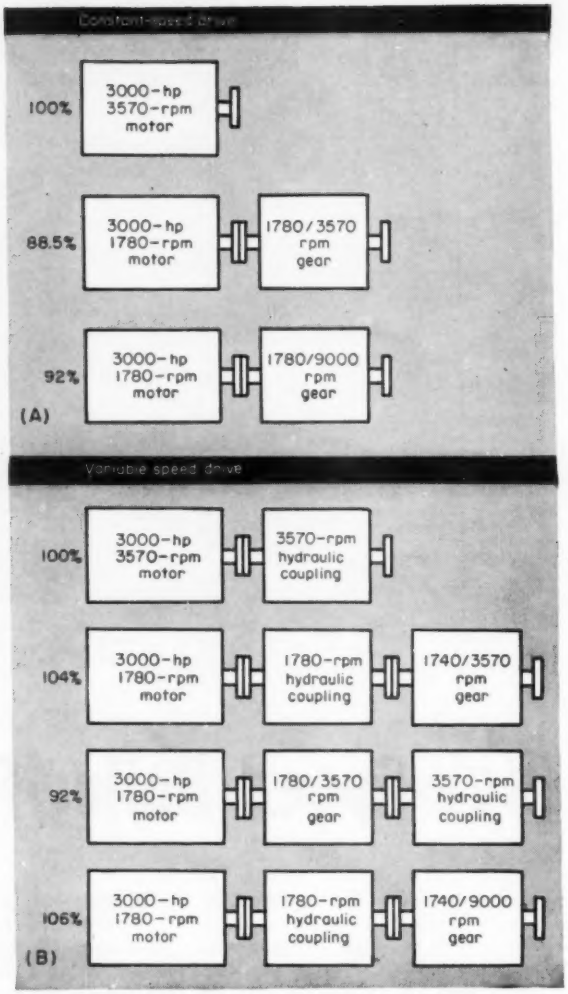
The amount of speed variation between full-load and no-load conditions will vary somewhat for different installations, but seldom exceeds the modest figure of 20% in today's plants operating at pressures to 2400 psi. Introduction of steam plants operating at pressures above the critical will increase this speed range appreciably because they will have much steeper system-head curves. Higher frictional losses in the pump discharge cause this increased steepness. And we may expect the no-load speed of the feed pumps to fall as low as 65% of full-load speed.

**Depending on** (1) shapes of the head-capacity curve at constant speed and of




**3** **DRIVES** for feed pumps in high and superpressure plants may develop as shown. Much depends on design, research

**The drive is an important factor in feed-pump design**




**4** **COST COMPARISON** for motor-drive arrangements for both constant and variable-speed hookups of motor and pump

the system-head curve (2) number of operating hours at various pump capacities and (3) value ascribed to power consumption, it is possible to arrive at the yearly savings with a variable-speed drive and, hence, at the capitalized savings. This permits establishing a cost per horsepower at which the savings justify installing a variable-speed device.

While the power saving is the only tangible item that lends itself to direct evaluation in dollars and cents, it is not the only advantage that may be derived from variable-speed operation. Further advantages are: (1) Elimination of the feedwater regulator, its attendant pressure losses, initial cost and maintenance. (2) Reduced wear in the pump at part capacities where most of the destructive action occurs and where a considerable portion of operation takes place. (3) Reduced maximum operating pressure on discharge piping and equipment (such as closed heaters in the feed-pump discharge).

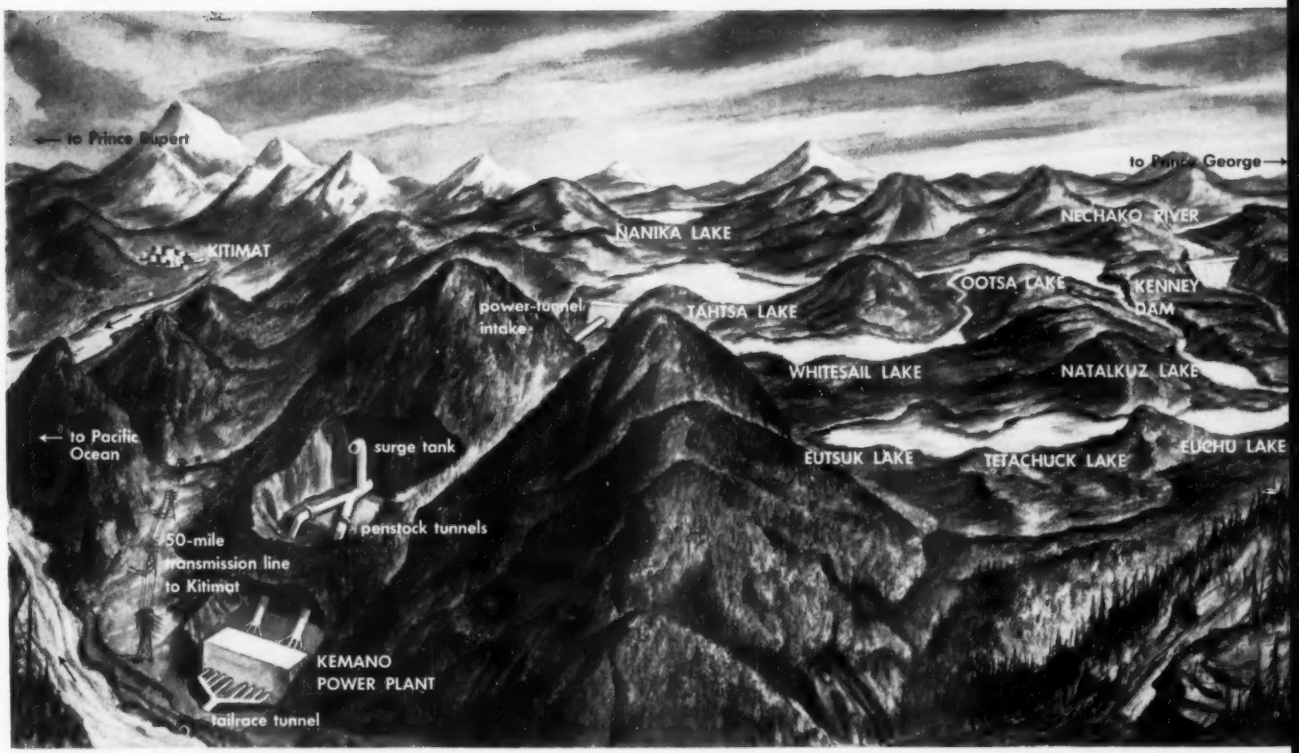
**In evaluating** the power-consumption savings derived from use of variable speed, remember that calculations must include the efficiency of the variable-speed device itself. In general, whether the device is a wound-rotor motor, a hydraulic coupling or a magnetic drive, losses incurred in speed reduction are approximately proportional to this reduction. For instance, consider a hydraulic coupling—which is typical of the variable-speed devices under consideration. The relation that determines the over-all power consumption of pump and variable-speed device is:

Input hp to variable-speed device = pump bhp (driver speed ÷ pump speed) + fixed hp losses

At full load, a hydraulic coupling has a slip of 1.5 to 3%, and fixed horsepower losses of 1 to 2%. So its best efficiency is about 95 to 98%. As the required speed of the pump decreases, so does the efficiency of the hydraulic coupling.

Fig. 1 illustrates typical performance at constant and variable speeds of a feed pump designed to handle 1500 gpm of 300-F water against a total head of 6000 feet. For simplicity, we assume that the specific gravity stays constant at all flows. Fig. 1 shows an assumed system-head curve, the pump speed required to meet this system-head curve, and power consumption at variable

(*Continued on page* 202)




**1** Spread over 5000 sq miles of wilderness, Alcan's British Columbia project, 400 miles north of Vancouver, extends about 150 miles from Kenney Dam on the east to power plant at Kemano and aluminum smelter and town site on Pacific coast

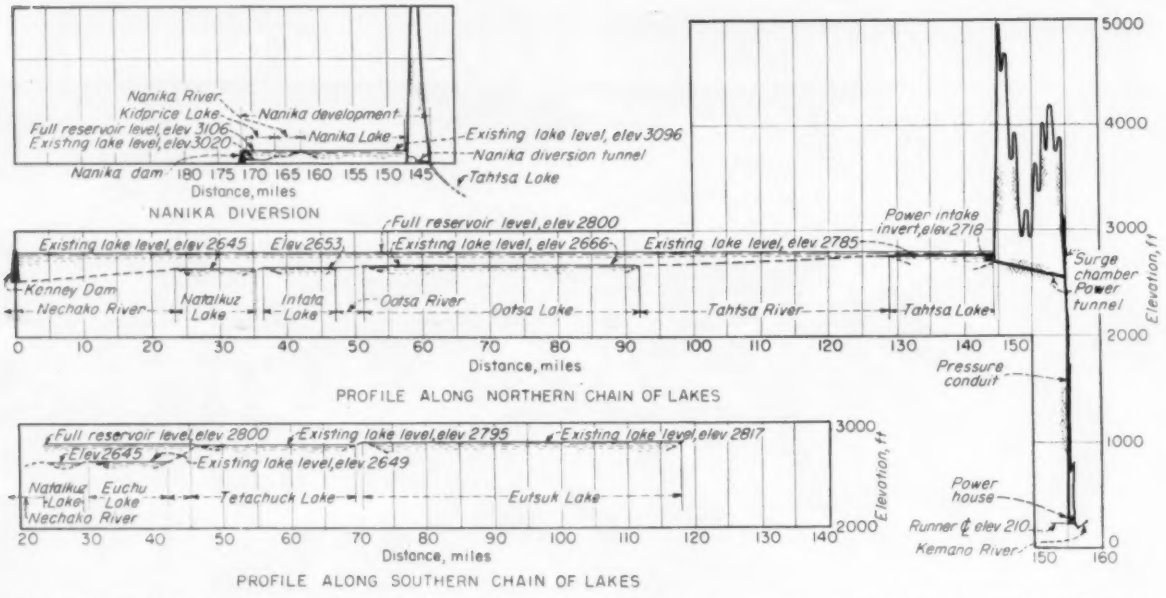
# High-Head Underground Hydro Plant

## ...will serve huge aluminum refinery in British Columbia

**2,240,000-hp high-head hydro plant will have 16 vertical-shaft 4-nozzle 140,000-hp impulse turbines to operate under 2500-ft head, served by largest pressure conduits. High rock-filled dam reverses river flow to form a 20-million acre-ft water-storage reservoir**

► RELATIVELY FEW AREAS combine cheap water power and transportation, the two essentials in large-scale low-cost aluminum production. One of these sites is in British Columbia, 400 miles northwest of Vancouver. Here, a great industrial empire is being built at Kitimat, an Indian village, by the Aluminum Company of Canada, commonly known as Alcan. It may ultimately be the largest aluminum-reduction plant in the world—500,000 tons per year—and one of the highest-capacity hydro-electric developments—2,240,000 hp.

**Project Site.** High in the mountains of the coastal range of British Columbia, 3000 ft above the Pacific, lies the fountain head of this vast project. When completed, it will cost $500 million. Here the Fraser River has its source in a series of seven long lakes, Fig. 1, and flows east through Nechako River. Existing surface elevation of these lakes varies from 2645 to 2785 ft above sea level, Fig. 2. Their flow will be reversed and taken into two tunnels through the mountains to the largest underground hydro plant in the world. It's on the Kemano River near the Pacific. *(Turn page)*




**2** Profile of Nechako reservoir shows how Kenney Dam will raise the level of seven mountain lakes to form one of the largest water-storage reservoirs, 20-million arce-ft capacity, to supply the world's largest underground hydro power plant

# Dam will raise level of seven lakes to form huge water-storage reservoir

Twenty-one miles below the outlet of Natalkuz Lake, the Nechako River flows through a deep gorge, known as the Grand Canyon. In it the world's third-largest rock-filled dam with an impervious clay core has been built. Known as Kenney Dam, it is 317 ft high with a crest 1550 ft in length by 40 ft wide, and contains 4 million cu yd of fill. While the dam was being built the river bypassed it through a horseshoe-shaped tunnel 32 ft in diameter and 1430 ft long. After completion of the dam the tunnel was closed and plugged with concrete.

Kenney Dam will raise the water level of the lakes to elevation 2800 with the exception of Nanika and Kidprice Lakes, whose elevation is about 3000 ft. They will be a later development.

Reservoir formed by the dam will have a storage capacity of 20-million acre-ft, which makes it one of the largest in the world. To fill it, flow from the watershed will be required for 3½ years. Completion of the Nanika-Kidprice storage will add 400,000 acre-ft, bringing the total to 20,400,000 acre-ft, with a surface area of 358 sq miles and a drainage area of 5500 sq miles. Later, when needed, diversion of the Nanika-Kidprice Lakes will require a dam 150 ft high by 800 ft long, about half a mile below the outlet of Kidprice Lake, as shown in the upper left of Fig. 2.

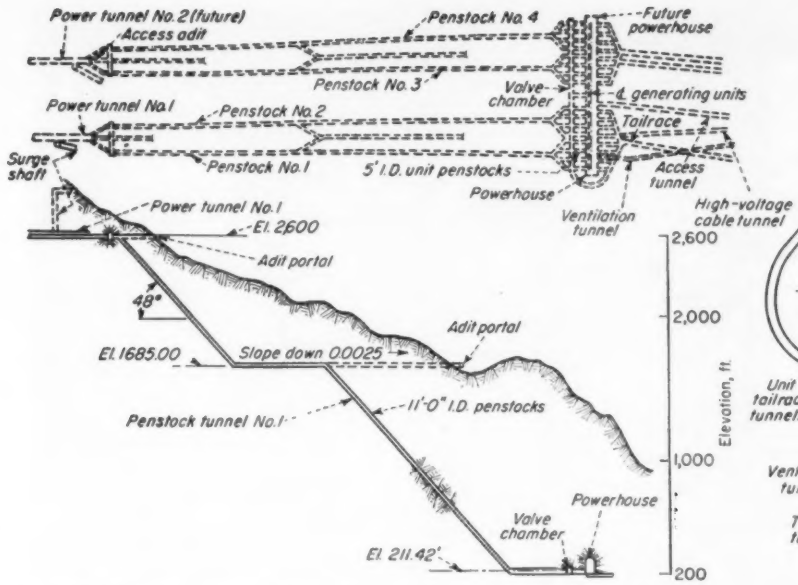
**Power Tunnels.** From an intake at the western end of Tahtsa Lake, two tunnels 25 ft in diameter (one at present) will be driven through the coastal-range mountains to a surge chamber on the Pacific slope, Fig. 1. Intakes to the tunnels will have guides for stop logs and fixed-wheel gates, and a trash rack to keep debris from tunnels and turbines. The power plant will start about two years before the storage reservoir has filled. During part of this time Tahtsa Lake drainage alone must supply the water for power generation.

The tunnels will be unlined, except about 25% of their length, where steel supports and an 18-in. concrete lining are required to support the rock and cut off water flow from it. Each tunnel will normally carry 3500-cfs, but is designed for 4500-cfs maximum flow.

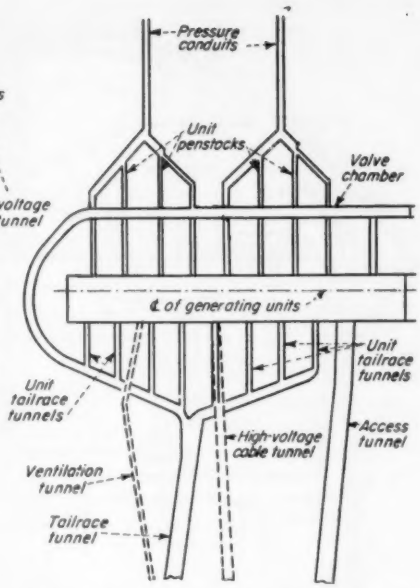
**Penstocks in Tunnels.** Near the discharge end of the tunnel is a surge chamber excavated in the mountain-side rock. Up to this point, the project follows North American practice closely. Beyond the tunnel, construction is unusual on this continent in that it is all underground, much like that for many European hydroelectric plants. Instead of installing the penstocks in the open on the mountain face they are placed in tunnels and sealed in the rock with concrete. This was done for several reasons. Among them are:

1. With suitable rock cover, saving in steel was considerable.
2. Massive concrete supports and foundation required for exposed penstocks are eliminated.
3. Protection is provided against air attacks in war.
4. Protection is given against forest fires, snow and rock slides.
5. No external inspection and maintenance are needed.
6. Penstock construction through the year is continuous. Without these tunnels, heavy, treacherous snow on steep mountain slopes where the plant is located would make such construction practically impossible in the open in winter.

**Penstock Arrangement.** Beyond the surge chamber a steel wye connects to the tunnel and branches into two penstocks 4000 ft long and 11 ft in diameter, Fig. 1 and 3. An 11-ft butterfly valve is placed in each penstock about 300 ft below the wye, followed by an air-inlet valve. The latter admits air into the penstock whenever it is drained for inspection and maintenance. At its lower end each penstock connects to a manifold from which four branches, each 5 ft in diameter, lead to an equal number of power units. Each branch has a spherical valve installed about 140 ft upstream from the center line of its turbine. Penstock-steel thickness varies




**3** Penstock tunnels connect to power conduits at elev 2600 through wye and butterfly valves, and run down to turbines




**4** Setup of penstocks and tailrace tunnels for first half of underground powerhouse. Eight main units will be installed

from 9/16 in. at the top to 2½ in. upstream from the manifold. Between the manifold and the turbine flange, steel plate in the 5-ft-diameter pipe is 2¾ in. thick. Under full static head of 2590 ft, pressure at the turbine nozzles is 1125 psig.

**Powerhouse Underground.** Even though little attention has been given to underground hydroelectric plants in North America, about 75 of them have been built or are under construction. They are in all kinds of climates ranging from above the arctic circle to sunny southern Italy. Neither head nor size limits their use. Heads range from 3540 to 18 ft, and flows from 15 to 1420 cfs. One of the world's first, if not the first, underground hydro power plant is at Snoqualmie Falls in the state of Washington. Completed in 1898, it has a capacity of 10,000 hp under a 270-ft head. All equipment, including turbines, generators and control boards, is in an unlined solid-rock chamber. This construction was adopted not for reasons of economy but to avoid excessive spray and ice conditions caused by the falls.

Aside from being free from enemy attack an underground power plant at Kemano is justified for several reasons:

1. Foundation for the massive plant equipment is obtained more economically.

2. Recent advances in rock excavation reduce the cost for this work.

3. As with the penstocks, work can be continued through the winter, which is important because of the time schedule for putting this huge plant into service.

4. Concrete for an underground plant is less than for one constructed in the open.

5. No structural maintenance is required.

6. Working conditions can be more uniform than in an outdoor plant, subject to wide temperature ranges and other weather conditions.

**Largest in World.** Kemano power plant when completed will be several times larger than any other underground plant both in physical dimensions and installed power capacity. A huge chamber will be excavated, 1134 ft long, 81½ ft wide, and 140 ft high from the bottom of the tailrace excavation to the top of the roof-arch rock, Fig. 5 and 7. Present powerhouse chamber excavation is 700 ft long, to provide space for eight units, three of which are being installed. To form the powerhouse chamber, 250,000 cu yd of rock had to be removed. With the exception of mines and tunnels this is one of the largest underground excavations in the world. This chamber will house the power-generating units, stepup transformers, their circuit breakers and all other power equipment except outdoor high-voltage switchyard.

In Fig. 5, the turbine-runner removal pit and staging with a track are below the runner. For removal, the runner is lowered on a car on the staging and taken out without disturbing the shaft or generator bearings. The runner is then taken to the repair area where the powerhouse crane can handle it.

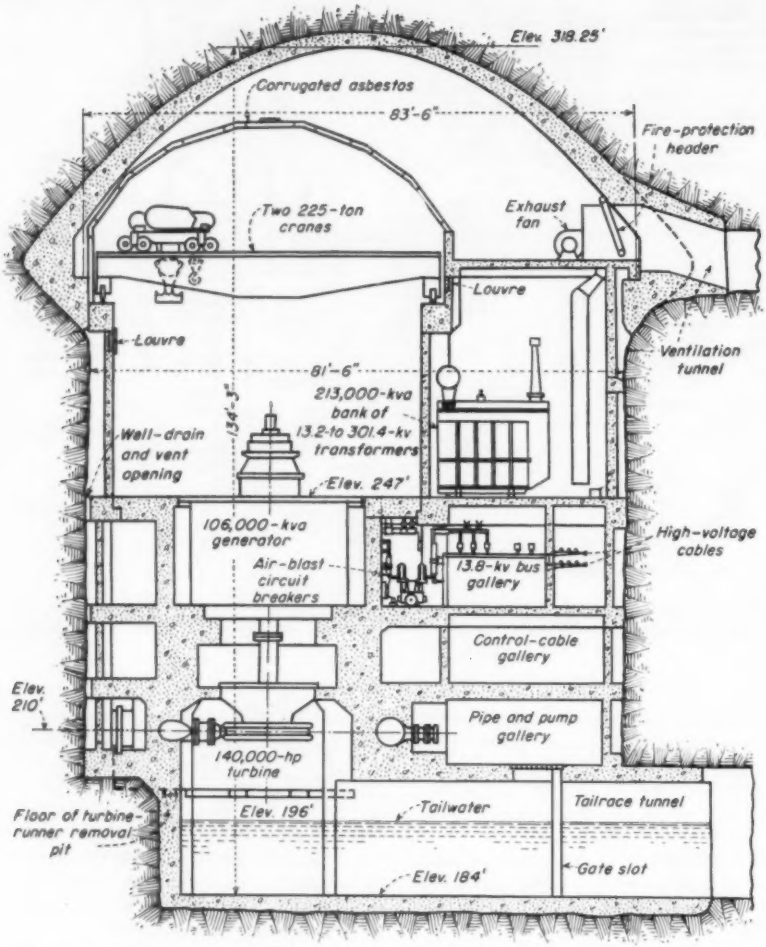
Fig. 4 shows the general arrangement of the pressure conduits (penstocks) and tailrace tunnels for the first half of the powerhouse. Water will come to the eight units through two main penstocks, each of which divides into four branches, one for each turbine. From the turbines, water goes into a tailrace tunnel and to the main discharge tunnel that empties into the Kemano River about 180 ft above sea level.

**Vertical Impulse Turbines.** When completed, the powerhouse will have installed 16 vertical-shaft, single-runner, 4-nozzle impulse turbines, each rated 140,000 hp at 327 rpm under a 2500-ft head. Center line of the turbines is at elevation 210 ft. With the reservoir full at elevation 2800, static head on the plant is 2590 ft. At normal rating of the turbines the plant's ultimate capacity is 2,240,000 hp.

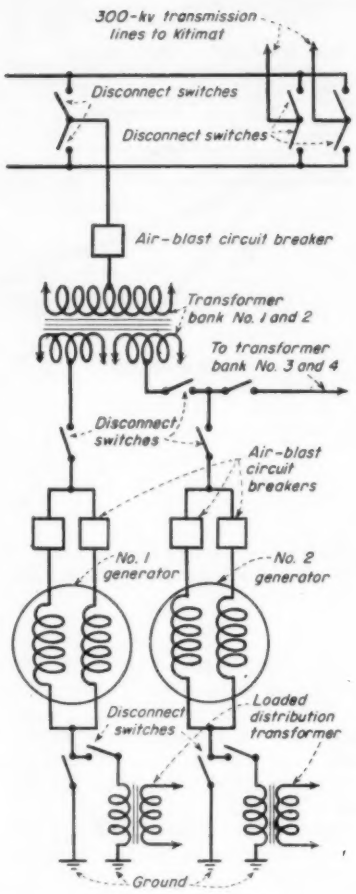
This makes it by far the largest high-head plant in the world, with about double the capacity of any hydro plant built by an industrial or public utility. Shipshaw No. 2 on the Saguenay River, next largest industrial plant, with 1,200,000-hp capacity, was also built by the

**Modernization Awards**

**For entry procedure, see page 100.**




**5** Cross section through the rock cavern, 82 ft wide, 1134 ft long and 140 ft high, in which power units, transformers and circuit breakers will be installed




**6** Single-line diagram for two of Kemano generators and transformer bank

# Largest underground hydroelectric plant

Aluminum Company of Canada. Kemano plant is exceeded in capacity by Grand Coulee only, which is now in operation with 3,102,000 hp installed in two plants, one located on each side of the river.

**Turbine Data.** The table gives data on the three turbines now being installed. Three different companies are building them. All three units have guaranteed maximum rating of 140,000 hp, but expected maximum output ranges from 147,000 to 158,000 hp. Guaranteed maximum efficiency is around 90% with an expected maximum of 92%, at 75% load.

Even though the runners have about the same diameter, 160 to 162 in., material from which the buckets are formed and the methods by which they are connected to their disk are quite different. On the Canadian Allis-Chalmers machine, the buckets are forged from steel plate and welded to their disk. Vancouver Engineering Works unit has cast mild-steel buckets, each fastened to its disk by two fitted bolts. Dominion Engineering Co buckets are of 13% chrome steel, cast integrally with the disk. Two of the units have Woodward governors, and the third a Pelton Water Wheel Co governor.

**Turbine Operation.** Because of the long tunnel and penstocks and other factors, turbine-nozzle closing time has to be limited by the governor to one minute and opening time to 30 seconds. Generally, nozzle opening time makes little difference in plant operation, but at Kemano it may be a serious operating factor. While there are only three units installed, a 100,000-kw aluminum-refining pot-line load may have to be picked up quickly on two turbines. A nozzle-needle, preset solenoid, actuated from the control room, handles this job.

After the turbines are brought to speed under governor control, the operator by the preset-needle solenoid increases the nozzle openings. This tends to overspeed the turbines. To keep the speed under control, the governors start deflecting the jets from the buckets. When the nozzles have been opened to about 75% full-load position, the control-room operator signals the aluminum-refinery operator at Kitimat, 50 miles away, to put on the pot-line load. When this is done, turbine speed starts to drop, causing the governors to return the jet deflectors to normal so the turbines quickly pick up about 75% of full load. This can be done in about three seconds without any effect on the hydraulic-flow conditions in pen-

**7** To form the powerhouse chamber, 250,000 cubic yards of rock had to be blasted and removed. The access tunnel for unit No. 5 penstock is shown on the left

## Water-Wheel and Generator Data

| Turbine No.<br>Turbine Manufacturer | 1<br>Canadian<br>Allis-Chalmers | 2<br>Vancouver<br>Engineering Works | 3<br>Dominion<br>Engineering Co. |
|---|---|---|---|
| Guaranteed max hp | 140,000 | 140,000 | 140,000 |
| Expected max hp | 147,000 | 150,000 | 158,000 |
| Guaranteed max efficiency, % | 89.5 | 90.0 | 89.5 |
| Expected max efficiency, % | 92.5 | 92.0 | 91.5 |
| Expected full-load eff, % | 90.2 | 89.5 | 88.8 |
| Expected ¾-load eff, % | 92.5 | 92.0 | 91.5 |
| Expected ½-load eff, % | 91.0 | 90.5 | 90.1 |
| Runner weight, lb | 72,000 | 89,900 | 48,000 |
| Runner diameter, in. | 160 | 162.0 | 162.0 |
| Buckets formed by | Forging | Casting | Casting |
| Bucket material | Steel plate | Mild steel | 13% cr steel |
| Bucket fastening | Welded to disk | Two fitted bolts | Cast with ring |
| Type of runner | Integrally welded | Bolted | Integrally cast |
| Governor manufacturer | Woodward | Pelton | Woodward |
| Generator manufacturer | Canadian General Elec | Canadian Westinghouse | English Electric |
| Output, kva | 106,000 | 106,000 | 106,000 |
| Power factor | 0.80 | 0.80 | 0.80 |
| Guaranteed full-load eff, % | 97.3 | 97.3 | 97.45 |
| Guaranteed ¾-load eff, % | 96.8 | 96.8 | 96.95 |
| Guaranteed ½-load eff, % | 95.3 | 96.0 | 95.90 |

stock and tunnel. Beyond 75% load, the governors increase the nozzle openings to increase flow to the turbines.

To prevent high overspeed when a large block of load is dropped, the governors quickly deflect the jets from the turbine runners. After this, the nozzles gradually close as the deflectors return to normal operating position. When several power units are running, one pot line will be a smaller part of the total load, and the operating procedure described will no longer be required except in emergencies.

**Generator Construction.** Each turbine couples to a generator, rated 106,000 kva at 60-C rise and 122,000 kva at 80-C rise, to operate at 13,800 v, 60 cycles. Rated speed is 327 rpm, but the machines are designed for 610-rpm runaway. Three different companies built them: Canadian General Electric, Canadian Westinghouse and English Electric. Each generator has a guaranteed full-load efficiency of 97.3%, or better, with a half-load efficiency of 95.3, or above.

Generators have a thrust and upper guide bearing above the rotor and a lower guide bearing. Above the thrust bearing is a main and a pilot exciter and the generator for supplying power to the governor-flyball motor. Six-phase leads are brought out from the generator windings, so split-phase relays may protect the machine. Six neutral leads are also brought out and connected so the generators may operate with their neutral solidly grounded or through a leaded distribution transformer, Fig. 6.

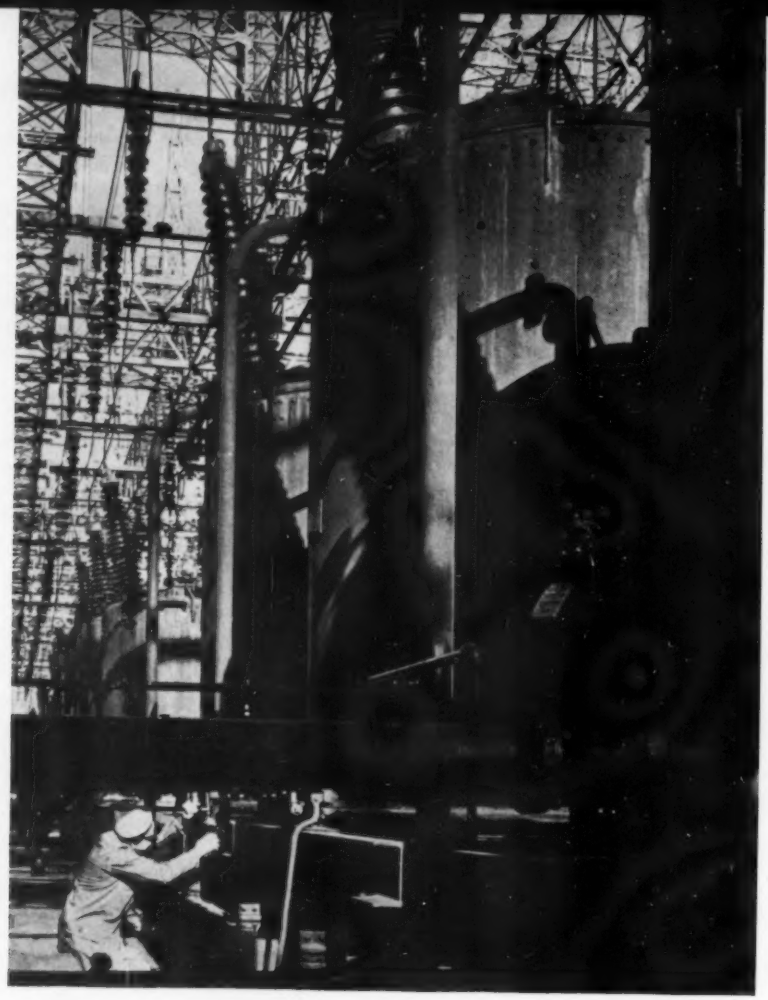
**Air-Blast Circuit Breakers.** Two standard air-blast circuit breakers in parallel connect each generator to the 13,800-v bus. Each breaker is rated 15-kv 4000-amp 1,900,000-kva interrupting capacity. Two breakers were used in parallel and operated as one electric and pneumatic unit, because single breakers of sufficient interrupting capacity were not readily available. Since the breakers are installed in the power plant, air-blast design has the additional advantages of eliminating oil-fire hazards. Beyond the air-blast breakers each pair of phase leads connect to a single disconnect switch and to the 13.8-kv bus, which connects to the stepup transformers.

**Transformers.** Conditions in the powerhouse limited weight of the transformer core and coils to not more than 150,000 lb, which dictated single-phase units. Also, to install the transformers within the same powerhouse length as required for the generators, two machines had to be connected to each transformer bank.

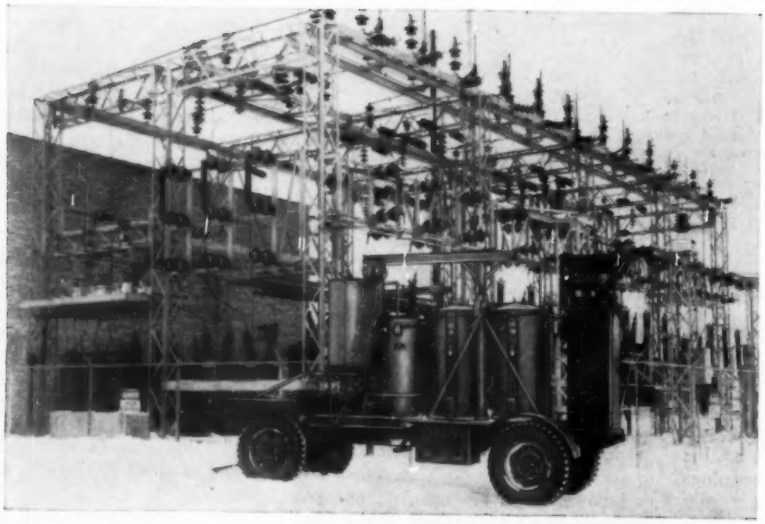
These transformers have two primary windings and are rated 71,000 kva, 13.2-13.2-301.4 kv, connected delta-delta-wye for a total bank capacity of 213,000 kva. These are among the highest-capacity transformer banks in the world. They are forced oil-water cooled in two separate heat exchangers, but can deliver rated capacity at 55-C rise with one cooler in operation. With two coolers in service the transformers can each be loaded to about 95,000 kva with a 62-C rise.

Each primary winding connects to one generator and can carry its full rated load independently of the other wind-

(*Continued on page* 196)



# Periodic Sample-Testing Tells When and...



# On-the-Job Purification Is How...

**Insulation level and heat transfer are influenced by the way an oil changes in service. Here's an outline of what these changes are, practicality of reclaiming and use of oxidation inhibitors**

Insulating oil does two jobs in a transformer: It insulates and serves as a heat-transfer medium. In a circuit breaker, oil helps quench the arc formed when breaker opens under load.

Oil for these jobs calls for a specific set of properties. Example: Transformer-oil viscosity must be low enough so oil circulates freely, carrying heat quickly from core to cooling surfaces. Likewise, low viscosity in circuit-breaker oil aids in dissipating products formed by the arc on opening.

In addition to viscosity other properties are important. Flash and fire points should be high enough for safety; low pour point permits free operation in cold weather. Water shouldn't be absorbed readily and any that is must settle out fast. This is an important property for circuit-breaker oils since breakers can't be closed off effectively as transformers can. Moisture-holding ability affects dielectric strength.

These are but a few of the requirements for a top-grade insulating oil. Most of today's oils supplied by the major oil companies will meet present-day needs.

*"Insulating oils start changing chemical makeup once they go into service"*

Rate of chemical change for any oil depends amongst other things on temperature, type transformer (free-breathing, conservator, gas-filled, sealed) and quality of oil used. Rate of chemical change doubles for each 18-F rise. And if oil deterioration products are present, as outlined below, there is a further stepping-up in deterioration by catalytic action.

Oil-deterioration products form slowly during the induction period. For inhibited oils this period is considerably longer than for straight mineral oils. Once induction is over, deterioration moves at a fast clip.

Insulating oil, like lubricating oil, doesn't wear out; it becomes unfit for service because of the small percentage (usually less than 1%) of impurities including oil-deterioration products and foreign particles. These deterioration products include acids, asphaltenes, resins, peroxides and water. Foreign materials include dust particles, water, carbon, sodium silicate, varnish from transformer, metallic particles, etc.

*"All foreign particles affect dielectric strength in presence of water cellulose fibers particularly"*

Water in oil is often in both soluble and free states. Solubility of water in oil is influenced by temperature and oil condition. As oil deteriorates, its water solubility increases; also, as temperature goes up the solubility increases. Deteriorated oil will not drop its free water easily and, consequently, the dielectric strength is affected materially. Free water has a marked effect on dielectric strength, while dissolved water has little.

Water is absorbed by fibers which may orient themselves across points of stress. This can lead to arcing. By contrast, clean oil can tolerate a sizable amount of pure water without dielectric breakdown. But it's rather difficult to keep a transformer oil completely free of all foreign materials. Particles or fibers from insulation or blotter-press papers may break loose and get in the oil. Most foreign particles cause little trouble dielectrically unless water is present. Foreign particles are eliminated with proper filtration equipment, and maximum water is removed by vacuum dehydrators.

As an oil ages in service *asphaltenes* are formed. Oil dissolves asphaltenes up to a point. But in time the oil becomes saturated and they start precipitating out as solids. If "oil aging" proceeds beyond a certain point, a blanket of asphaltenes forms over all oil-immersed transformer parts. A heavier blanket envelopes the cooler parts, like cooling coils. If left unchecked, deposition continues until cooling tubes lose efficiency; they may become clogged with solids. Clogging retards heat removal so transformer operates at higher temperatures under any given load. Higher temperature causes a still higher rate of oil deterioration—a closed cycle of events.

Deposits may form a well-defined pattern like lines in a magnetic field. Sludges are polar molecules whose electrostatic charge reacts with lines of transformer electrical stress. However, oil convection currents tend to minimize this tendency to concentrate in high-stress areas.

Water, acids and peroxides all tend to attack and weaken cellulose insulation. After long use insulation may become weakened to the point where it becomes dangerous to remove transformer oil for fear of actually breaking the insulation. Oil has a certain buoyancy and, if drained, the added strain may break insulation leading to transformer failure shortly after unit is back in service. If you suspect a transformer has reached this stage, don't drain oil for reclaiming or replacement, but rather recondition it in the transformer.

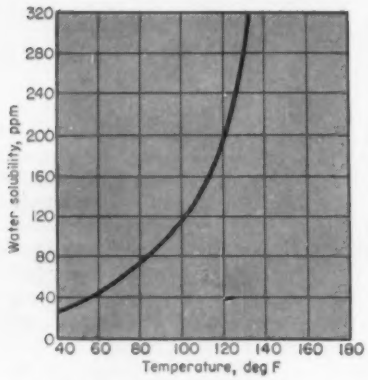
*"What single test best indicates condition of an insulating oil?"*

The question is, "What single condition are you interested in: dielectric strength, acid condition, sludging tendency, viscosity, etc?" No single test judges both the chemical and physical condition of an insulating oil. Each test is significant within its limits and gives only general information about an oil's over-all condition. Unless you have an equipped laboratory, some tests, such as stability, viscosity, fire and flash points, must be performed in outside laboratories.

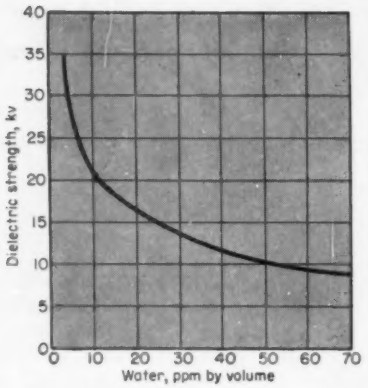
Since insulating oils are supplied with definite physical and chemical properties, it is usually unnecessary for the user to run through all the conventional oil tests. Dielectric-strength test is about the only test necessary on new oil. On

By JOHN R McCOY, *Manager, Technical Service, Honan-Crane Corp*

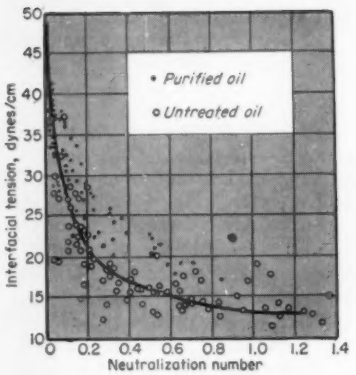
# ...Today's Insulating Oils Should Be Maintained




**SOLUBILITY** of water in oil goes up as temperature and contamination increase




**DIELECTRIC** strength affected by amount of water and foreign matter in the oil




**FULLER'S-EARTH** treatment generally increases the interfacial tension value

# Consider possible savings from increasing inhibitor dose while

used oils, power factor, dielectric strength, neutralization number, interfacial tension, and color are tests most frequently used.

Dielectric strength is a must on all oils, new or used, because if insulating value is low, oil is unfit for use regardless of any other conditions. Federal specifications call for a minimum dielectric strength of 23 kv, rather low by present-day standards. With modern purification equipment, it is no trick to increase the dielectric strength to 35 kv and higher. Remember, if dry, a deteriorated oil may show a high dielectric-strength value.

Power factor is a good single-screening test. A low pf usually means little can be wrong with the oil. But high power factor points up need for further tests to pin down what may be wrong. When oil has high interfacial tension and is free from insoluble impurities, a high power factor probably means water is present.

Chemical condition is found by neutralization number and interfacial tension tests. Neutralization number is an easy test to run and often serves as a deterioration index. There is a difference of opinion as to how high a neutralization number can go before oil is considered unfit for further service; figure may range from 0.25 to 1.0. Most operators consider 0.4 to 0.6 as approaching the danger zone where oil starts precipitating sludge.

At present there are two tests often used for neutralization number. One is the old ASTM Number D-663-46T phenolphthalein color-indicator method. Newer is ASTM procedure Number D-974-48T, using a benzene-isopropyl alcohol mixture as a solvent and alphanaphthol benzene as an indicator. Although the ASTM no longer lists the phenolphthalein method, most power companies still use it. There is some difference in results by the two methods. New method gives slightly higher values in upper range.

Interfacial tension test has become a rather important test to predict when oil will start sludging. It shows up presence of polar molecules; and oil-deterioration products are polar molecules. A rather delicate test, interfacial tension shows up minute quantities of deterioration products before they can be detected by other methods. Unfortunately, this test is affected by varnish, soaps, sodium silicate, etc.

*"Oils start sludging after interfacial tension drops below about 20 dynes per cm"*

This holds if the low interfacial tension is caused by oil deterioration products. The lower the value, the greater the possibility of sludging.

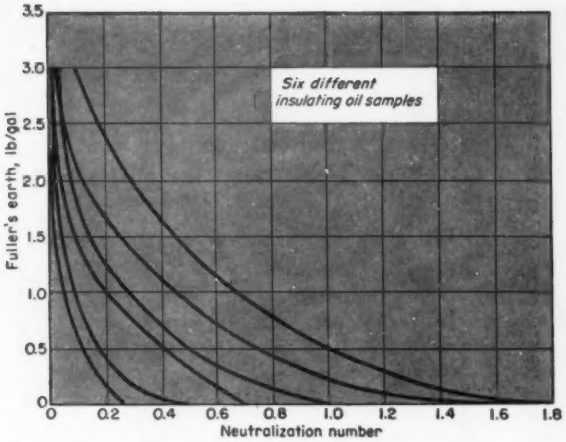
There is no direct correlation between interfacial tension and neutralization number, but there is a general trend, *sketch above*. An untreated oil practically always has a lower interfacial tension than an oil of same neutralization number that has been treated with fuller's earth. It can be assumed that if interfacial tension is at an acceptable level, the neutralization number will also have an acceptable value. However, the reverse is not true.

Color is a relatively unimportant test. As an oil deteriorates it becomes darker but the degree of darkness depends both on the particular oil and the amount of deterioration. Some oils tend to darken faster than others. Many substances used in the manufacture of oil-filled equipment, if dissolved, tend to darken the oil without changing its usefulness.

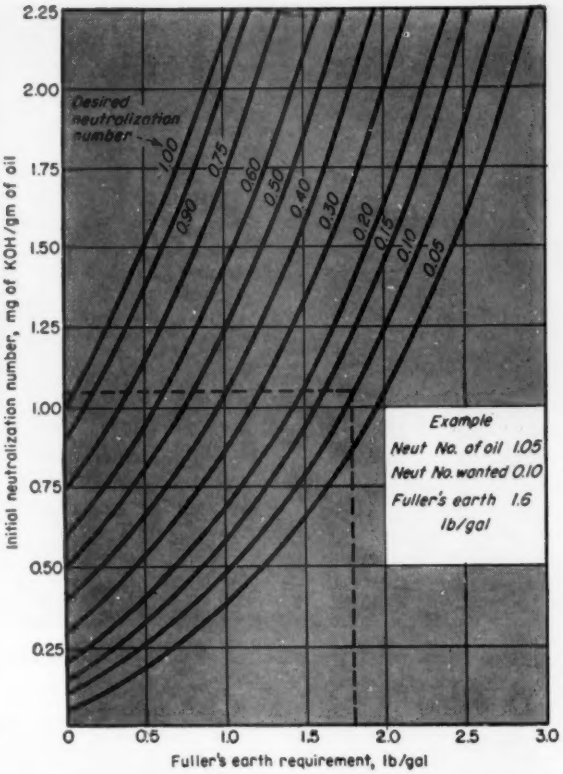
Today, many operators are purifying oil in energized equipment. The ideal time to reclaim a transformer oil is before it starts sludging and before acidity is excessive. There is a difference of opinion among various operators as to when this point is reached. Some operators use interfacial tension as the yardstick, others use neutralization number. Several tests are necessary to get a complete picture of oil condition.

*"Dielectric strength test is no indication of an oil's chemical condition"*

Don't use dielectric strength test as a yardstick to tell when oil needs reclaiming. If dielectric strength is low, the oil should be dehydrated but not necessarily reclaimed. A light




**FINAL VALUE** of neutralization number after purifying with fuller's earth hinges somewhat on oil's neut value at start




**NEUTRALIZATION NUMBER** wanted can be had if you know number for the used oil; above chart assumes a top-grade earth

# using less fuller's earth

fuller's-earth treatment at the time an oil is dehydrated is usually desirable even though the oil may not require a major reclaiming.

Ideal time to reclaim an oil is before interfacial tension goes below 20 dynes. Operator is then assured no sludging has taken place. But since time and expense do not usually allow reclaiming at this level, most operators prefer to reclaim their oil when interfacial tension gets down to about 16 dynes, or neutralization number has risen to 0.4—0.6.

*"By removing oxygen and water from oil, you reduce the effects of high temperatures"*

Adsorbent treatment removes both soluble and insoluble contaminants. Fuller's earth has proved the most economical adsorbent. However, fuller's earth is not a chemical-treating process but an adsorption process. The earth actually reaches out and grabs oil-deterioration products, both soluble and insoluble, and puts nothing into the oil in return. In a chemical-treating process, products of neutralization usually are left in the oil and further treatment is required to remove them. Fuller's earth depends on its large surface area, 630,000 sq ft per lb, for its high adsorptive action.

Both soluble and insoluble water can be removed by vacuum dehydration. Spray-type vacuum dehydration removes all free water and reduces the soluble water to less than 20 parts per million. This allows a rather large safety factor from a dielectric-strength standpoint. Any water getting into the oil goes into solution and will not materially affect dielectric strength until oil reaches its water-saturation point.

Blotter-press treatment depends on maximum dryness of blotters for water removal. Press blotters will re-absorb from the atmosphere, in three or four minutes, over one-half the moisture that it has taken hours to remove. So use dried blotters immediately after removing from oven.

Blotter presses and centrifuges will not remove soluble contamination, such as acids and soluble asphaltenes. Consequently they do not reduce tendency of oil to sludge. Oil will still have its high affinity for water, both free and dissolved, and will quickly pick up more water to reduce its dielectric strength. Don't use blotter press on energized units since it is considered poor operating practice.

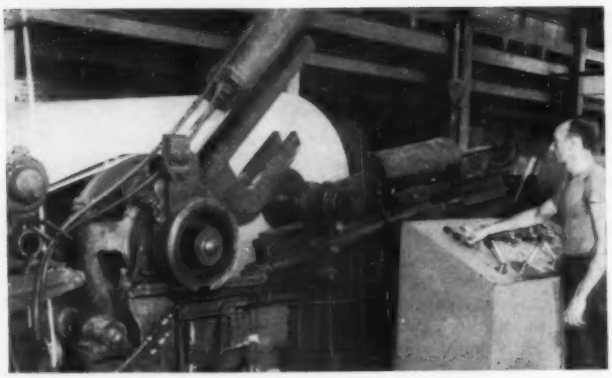
Removing sludge increases cooling efficiency, thus reducing oxidation. Decrease in oxidation reduces emulsification of water in oil, thereby lowering tendency toward lower dielectric strength. When fibrous and other foreign particles are taken out, the harmful effect of any water present is reduced. So remove as completely as possible, from both oil and transformer, all oil deterioration products and foreign contaminants. This step minimizes further deterioration by catalytic action.

If transformers are continued in service for long periods without proper maintenance, they may become so filled with sludge that it becomes necessary to remove them from service for reconditioning. This means draining oil, pulling the core, complete cleaning, drying, reassembling, and refilling with oil after it has been purified. This is a costly, time-consuming procedure. More practical method is to clean the units while still in service before they reach the stage where they must be manually cleaned. This can be done by circulating oil from transformer through a properly designed oil-reclaiming unit. All oil entering the energized transformer from the reclaiming unit must be thoroughly dehydrated and degasified to prevent arcing.

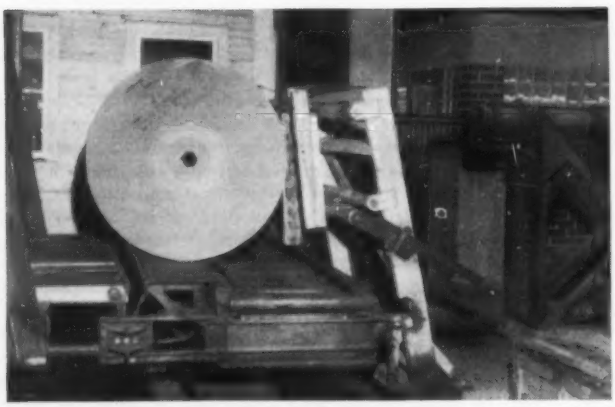
Circulation of oil through transformer flushes out loose solids. On badly sludged transformers, asphaltenes will have adhered so well to some surfaces that they will not be washed loose by simply passing the oil through a reclaimer.

(*Continued on page* 214)

**Removing and replacing heavy bolts . . .**



**Roll changing and pressure control . . .**



**And moving heavy products**

By **WILLIAM H WHEELER**
*Manager, Vertical Air-Compressor Division*
*Worthington Corporation*

**With air-operated**

Labor-saving tools

Process controls

Product handlers

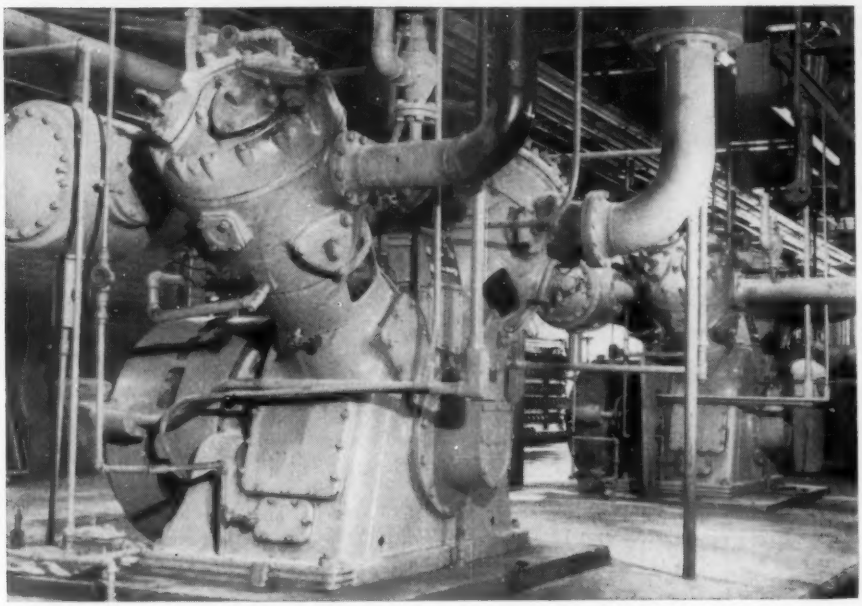
Safety devices, etc. . . .

# You Can Put

► COMPRESSED AIR can solve a multitude of problems in maintenance, control and product handling. You know that. Your plant has an air system, and you use it for some of the many applications possible. But how long has it been since you took a good look at the setup to see what additional jobs air can do for you? Engineers at the Macon Kraft Co took such a look, and when they became air conscious they turned up a lot of ideas that can be put to work in your plant as well as theirs.

In Macon, Georgia, this company manufactures paper container board. They use eight digesters to prepare pine chips for making the paper. These digesters are 6-story-high steel containers. The paper machine itself is a single unit, 600 ft long, and has 105 drying rolls that are 5 ft in diameter and 18 ft long. With this background, let's see how they put compressed air to work.

**Air-Driven Tools.** Your plant probably uses compressed-air-powered tools for maintenance. Macon Kraft also takes advantage of the potentialities of air in their everyday upkeep problems. To keep the machinery and factory building in tiptop shape, their men use pneumatic



**COMPRESSORS,** 200-hp Y-type, supply air for a wide range of applications at Macon Kraft

# Compressed Air to Work at New Jobs

scaling, chipping and riveting hammers; air-operated rotary drills, grinders, reamers, buffers and brushes; and heavier air tools, such as concrete breakers and hammer drills.

Here are some of the usual advantages they obtain from air-driven tools: A lot of power is packed in little weight; there is no fire or shock hazard involved; the tools can stall without danger to the operator or to the tool. In the warm climate of Georgia, the operators have the added convenience of being cooled by the expanding air discharging from the tools.

Macon Kraft saves time and labor in a major phase of the process by using compressed air. The eight digester heads, secured by 15 swing bolts, must be removed and replaced 50 to 60 times a day to charge the digesters with wood chips. The illustration, *top of facing page*, shows how they solved this problem with an air-impact wrench. One or two men are now needed for the job where previously a crew of men was necessary.

**Process Controls.** In the first phases of the manufacture of paper container board in the paper machine, the fibrous mass must go, unsupported, from a continuous felt-conveyor ribbon to the next felt-conveyor ribbon. In making the transition, the tension on the fiber mass must be held within close limits to prevent the paper from being pulled apart with too much tension, or losing its uniformity with too little tension. To do this, the rolls on either side of the "gap" are mounted on air cylinders. The air pressure in the cylinders holds tension constant.

An air-operated valve delivers digester samples to the operator at the operating level. He merely flicks a switch on the control board, which saves him a trip four levels down where temperatures are well over 100 F.

**Product Handling.** The illustration, *center on facing page*, shows the finished container board being rolled onto a core. The air cylinder to the right and its twin at the other side of the roll (not shown) control the pressure between the roll of container board and the last roll of the machine. This gives the desired tightness to the finished paperboard roll.

The second cylinder and jaw shown in the illustration are one assembly. There is a like assembly at the other side of the machine. The air cylinders rotate these assemblies about the axis of the last roll of the machine. The assembly is pictured as it rotates counterclockwise to the vertical position. At this time, it will receive a new core in its jaws.

When the paper roll shown is 6 feet in diameter, the paper feed is transferred to the new core, and the completed roll of paperboard is removed from the machine. The air cylinders rotate the new roll from the vertical position to the control of the pressure-regulating cylinders. Cylinder and jaw assembly then rotate to the left to repeat the cycle.

Compressed air is used to move the completed paperboard part of the way to the boxcars. Air cylinders tilt the floor plates under the roll, causing it to move to a conveyor. The roll goes from the conveyor to a carriage, and the car-

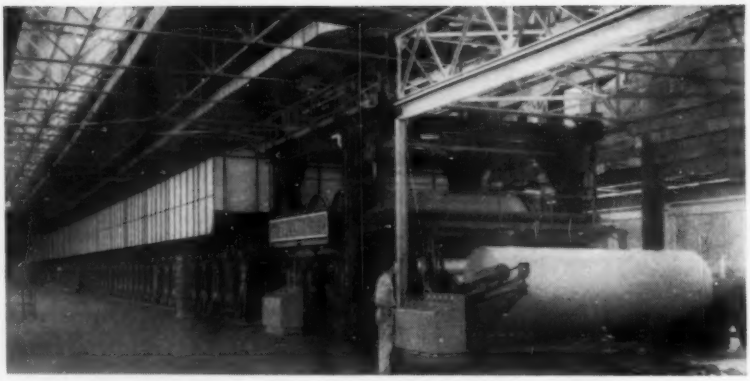
**Modernization Awards**

**For entry procedure, see page 100.**

riage takes it to an elevator. An air cylinder pushes the roll from the carriage to the lowering platform of the elevator. See the bottom illustration on page 94.

**Safety Device.** Discharge of cooked fibers from the digesters is normally controlled through a large screw-type, electrically operated valve at the digester base. However, the valve is not fast enough for emergency closing. To solve this problem, air-operated valves were installed on two of the digesters. These valves operate almost instantaneously because of the tremendous impact power available in compressed air.

**Transmission Control.** Eleven input stations feed power into the paper machine from a line shaft by means of air clutches. An entire section of the paper machine may be disengaged by merely throwing a lever. Air also supplies the braking force should it be necessary to stop the section for any reason.



**COMPRESSED AIR** supplies the punch in this process. How about yours?

**Compressors.** The mill-supply air compressors operate at 80 to 90 psi. The two machines are Worthington 2-stage watercooled vertical angle-type compressors, 18½x11½x8½ in., each driven by a close-coupled 200-hp 514-rpm 2300-v 3-ph 60-cps 0.8-pf (leading) synchronous motor. Each compressor has a displacement of 1035 cfm. The regulation is of the 5-step control type.

**WET STEAM** discharging from 8-inch diameter bore, 1000 feet in depth

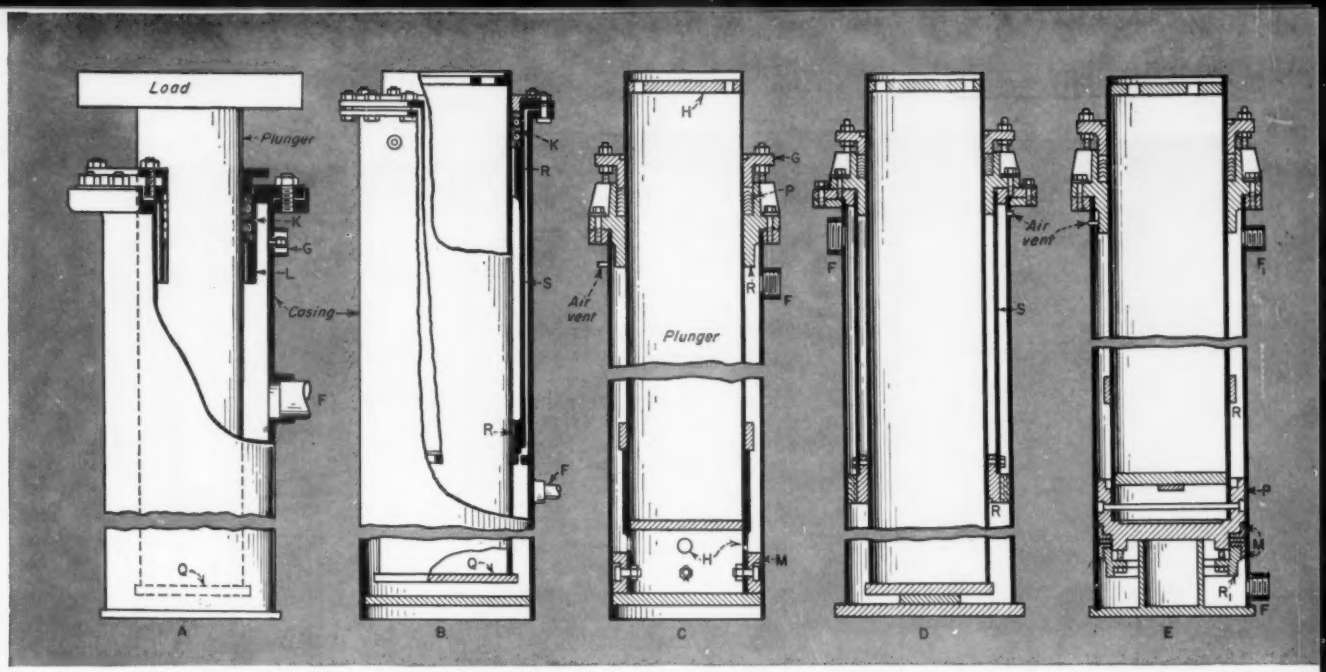
## NEW ZEALAND ENGINEERS HARNESSING GEOTHERMAL POWER POTENTIAL

Engineers are making plans for a pilot geothermal-powered plant at Wairakei Field, a small portion of the New Zealand thermal belt. The plant was initially planned for an output of 20,000 kw. But, as more and deeper bores were made it became apparent that the initial estimates were low. A much greater output is now being planned for the first installation.

The geothermal sources in New Zealand are close to the surface. However, pumice and compacted volcanic ash, saturated with water well above atmospheric boiling point, must be drilled to get to the power source. A rather elaborate rig is needed to make this drilling possible. The pumice has to be bound into a solid block with concrete, and the drill casing anchored to the block.

Steam from the bores at Wairakei has very low chemical content and practically no entrained gases.

Nearly all the bores produce very wet steam, and separators must be used.




**1** Today's elevator jacks: *A*, single-bearing plunger for guided loads. *B*, 2-bearing plunger for off-balance loads. *C*, a movable-bearing plunger for heavy service. *D*, cage-bearing for long-stroke service. *E*, a modern double-acting plunger

# Hydraulic Units Stage Comeback in Modern Low-Rise Elevators and Lifts

**Oil-powered units, controlled electrohydraulically, are being fitted to a host of new jobs. Here's timely info on their operation and application**

By F A ANNETT, *Contributing Editor*

► About 40 years ago, hydraulic elevators reached their acceptance peak for low- and high-rise applications. Then they were gradually superseded by the electric types. One hydraulic design required a plunger casing that went into the ground as far as the car went up: in some buildings 30 stories or more. Many such machines are still operating although frequently with modern electric control in place of their original mechanical scheme.

**Electrohydraulic.** Operating principle of those old plunger elevators is again being applied in many of today's lifts, freight and passenger elevators. But there are some major differences. Example: Old hydraulics operated from a common pressure tank, while modern units have individual pressure systems. Oil supply is through a motor-driven positive-displacement pump, actuated by an electric-hydraulic control system.

To send car up pump is started, discharging oil into the pressure cylinder around plunger (ram) until car reaches the desired floor. Pump is then stopped. Car is lowered by releasing oil from pressure cylinder, back into the storage tank.

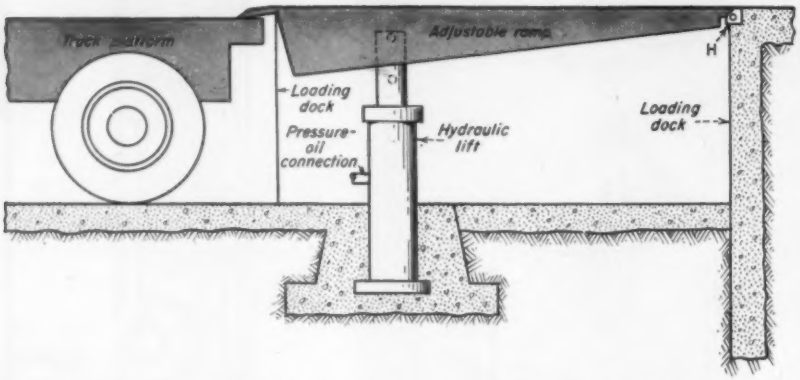
Electrohydraulic is an appropriate name for this type elevator or lift since it is a combination of the old hydraulic-plunger type with an electric motor and electric-hydraulic control. In the modern units oil serves as the pressure fluid in contrast to water in the old machines. Oil has eliminated many troubles associated with water, such as rust, corrosion and danger of freezing.

**Single-bearing cylinders** operate like a hydraulic jack: Liquid under pressure forces plunger up, lifting the load, Fig. 1*A*. A cylinder or outer casing of heavy steel is generally sunk in the ground as far as the load rises. A plunger, also of thick-walled steel tubing and polished to a mirror finish, connects to load. It is sealed in top of cylinder with compression packing *K*.

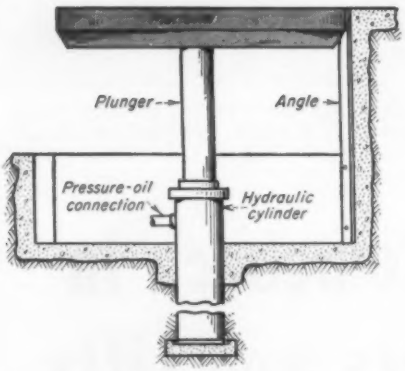
Babbitt-lined steel bearing *L* reduces friction and prevents plunger scoring. Oil under pressure is admitted near top of cylinder through connection *F*. Bleeder *G* removes air from system, preventing jerky operation of lift. Stop plate *Q* welded to plunger bottom prevents the plunger from being forced out of casing. At top end, a welded bulkhead fastens plunger to car sling or to the bottom struts of lift.

**Off-Balance Loads.** Cylinders having a single bearing at the top are suited for elevator and sidewalk lifts where car is guided top and bottom. Guides prevent off-balance loads from forcing plunger off vertical and placing a side thrust on cylinder bearing. Where the platform is not guided, as on many lifts, several cylinder designs are being used to give plunger greater support against off-balance loads.

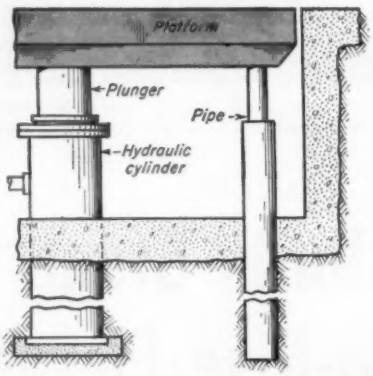
One such cylinder, Fig.1*B*, has two widely spaced steel rings, *R*, electrically



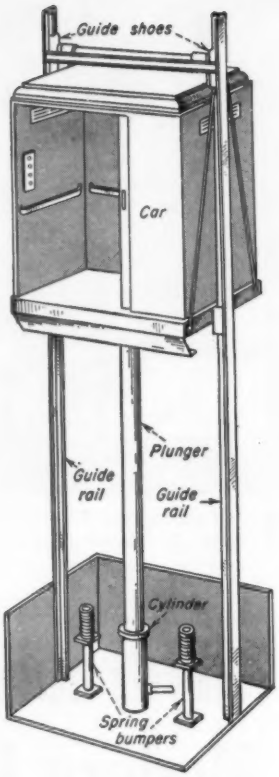

**2** Adjustable ramp in a loading dock has its rear end hinged to the dock at *H*, while the front end is connected to a hydraulic lift through a swivel bolster




**3** Here the hydraulic lift consists of platform only, mounted on a plunger




**4** Pipe may be used to prevent rotation when lift is in center of plant floor




**5** Hydraulic elevator is highly refined development of the hydraulic lift

## Adoption of modern control techniques is basis for recent growth in hydraulic lift applications

welded into a thick-walled steel barrel *S*. Rings have babbitt faces to take side thrust, giving smooth operation and preventing scoring of plunger. Both bearings always operate immersed in oil. Top of cylinder is sealed with square and round hollow-core compression packing *K*. Under ordinary conditions hollow core automatically adjusts pressure on packing to compensate for wear.

**Movable Bearing.** Additional fluid cylinder and plunger designs for off-center loads are shown in Fig. 1*C* to 1*E*. Design in Fig. 1*C* may be used for general industrial applications since heavy-service plunger and cylinder walls will stand stress of heavy off-center loads. Movable bearing *M*, fitted to lower end of plunger, gives added support against such loads. Plunger is supported by a removable bearing *R* at cylinder top that contains the packing. Five rings of chevron packing *P*, held under gland *G*, seal plunger in the cylinder. Oil under pressure is admitted at *F*, flows down between plunger and cylinder wall, through holes *H*, then under the plunger to lift load.

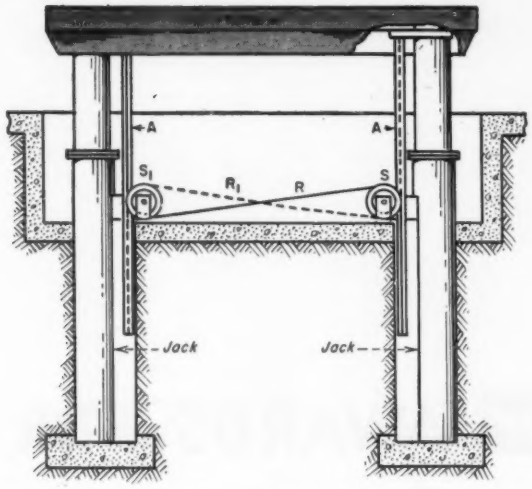
**Cage Bearing.** Design in Fig. 1*D* has cage bearing *R*, supported by cylinder *S* about 3 ft down from main cylinder head. Oil under pressure enters at *F*, passes down through holes in bearing, then below plunger to lift load. This design is adapted for long-stroke service where platform rise is higher than usual: loading, production, bridge-lift service.

**Double-Acting Cylinder.** Where platform is not heavy enough to insure gravity lowering, a double-acting cylinder, Fig. 1*E*, may be used. It is also applied where cylinder must be mounted horizontally for power operation on out and return strokes. Plunger is sealed in cylinder top as in Fig 1*C* and 1*D*. Piston *P* fastens to plunger bottom and is sealed in cylinder by two mechanical packings *M*, preventing leakage in either direction.

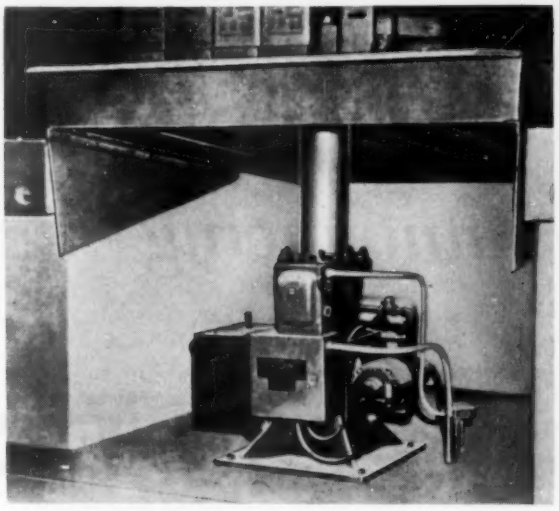
A short section of pipe fastened to bottom of cylinder prevents the load landing on bull ring *R*, which holds packing in place. This ring is welded to plunger and stops piston before bottom bearing strikes cylinder head. To lift load, pressure oil is admitted below the piston at *F*. When platform is lowered, pressure oil flows in at $F_1$ above the piston and out at *F* below.

There are other jack designs, but those described give a good general idea of the types used. Jack-plunger sizes range from 2.5 in. diameter on small low-capacity lifts to 18 in. on large heavy lifts, operating at 150 to 300 psi. This range of plunger sizes and pressures takes care of most load requirements.

**Applications.** One of the most common hydraulic-lift applications is that in automobile service stations. Same type lift is used in many industrial plants. Typical industrial application would be an adjustable ramp on loading dock, Fig. 2. Ramp hinges to dock at *H*, while its front end connects to a hydraulic lift through a swivel linkage bolster, bolted to ramp's underside.




**6** Two or more jacks are used where a single hydraulic cylinder and plunger fail to give enough stability to platform



**7** Adjustable loading ramp with hydraulic lift on which are assembled motor, pump, valves, piping, forming compact unit

Outer end of ramp is flush with side of dock, but is raised above truck-bed level before truck backs in. After it is in position, ramp is lowered until the bridge plate rests on its bed, Fig. 2. Pressure is then relieved under plunger, after which ramp follows up or down with the truck bed as load is put on or removed. This permits a fast, smooth flow of work on or off truck. Hydraulic cylinder sets in floor under ramp.

**Platform Lifts.** Of the many types of hydraulic lifts available, one has the platform alone mounted on a hydraulic plunger (jack), Fig. 3. Such an installation could be used to: (1) handle freight from a plant floor into trucks, freight cars or different building levels (2) position material for machine feeding (3) lift heavy loads in a host of possible applications.

Platform of a single-plunger lift can turn freely with the plunger so it must be held from rotating during up and down travel. Platform inner corners, Fig. 3, run in a pair of heavy angles extending from lower to upper landing. Where there is no adjacent wall to fasten angles, as when lift is installed in center of floor, a pipe may be used to prevent rotation, Fig. 4. Even though the pipe keeps platform from turning it does not relieve plunger and cylinder of side thrust or loading shocks. For maximum effectiveness, locate pipe as far as possible from jack.

**Dual-Plungers.** Several jacks may be used to get maximum platform stability, Fig. 6. Seldom is it necessary to use more than two jacks, but four have been used on a circular stage lift. To keep platform level with but two jacks under all load conditions calls for an equalizing system. Typical would be channel-iron struts, *A* in Fig. 6, that run from platform near top of each plunger down into jack well.

Bearing support for two double-grooved sheaves, *S* and $S_1$, connects to each cylinder. One pair of wire ropes anchored to top of right strut drops down and under sheave *S*, up and over sheave $S_1$, then down again to bottom of left strut. Other two ropes anchor to top of left strut, come down and under other $S_1$ sheave, then up and over other *S* sheave, to bottom end of right strut.

**How It Works.** When load on right side of platform is greater than left, platform tends to get out of plumb and left end tries to rise. But lower end of right strut connects to top end of left through ropes *R*. These ropes form a mechanical tie between bottom of right strut and top of left strut. As a result, the right end of platform cannot go down without also pulling down the left end.

Now let's reverse load so left end of platform has greatest load. Note that this end cannot go down without also pulling right end with it since rope $R_1$ serves as a mechanical tie between platform ends. In brief, equalizer ropes hold platform level under all loading conditions. At no time is the equalizing system loaded more than one-half the difference in load on both ends of platform.

Hydraulic system of dual jacks consists of a single power unit with a pipe leading to a manifold. From manifold a line runs to top of each jack cylinder. Otherwise, both power unit and control system are the same as for a single jack used for the same purpose.

**Other Equalizers.** Another equalizer system uses gears rather than ropes. Platform ends are connected through gears, one at each end of a shaft supported in two bearings and extending from one jack to the other. Strut connects to platform at each jack, as in Fig. 6. Shaft gears mesh into rack-gear on each strut. Equalizer ties together lift ends so one cannot move unless the other moves in same direction and at same rate. A third type of equalizer meters fluid to jacks so each moves at same rate, keeping platform level.

One feature of lifts we have studied is their extreme simplicity and how they may easily be adapted to a variety of low-rise jobs. All working parts are below floor level so when lift is lowered its platform may form a part of the floor without any obstructions above. On some smaller lifts, the pumps, valves and piping are assembled on the jack, Fig. 7. With this arrangement the only equipment above floor level is the push-

(*Continued on page 212*)

**POWER**

**Modernization Awards**

**For entry procedure, see page 100.**

# *Announcing*

# THE Power AWARDS FOR

## *to encourage planning for future modernizations, and to recognize meritorious completed programs*

■ Always a good idea, modernization has special importance now. The reasons are clear. We've just come through a period of heavy pressure on plant expansion, coupled with shortages of materials and equipment. Many plants that came out of the war years needing renovation still wait for it. And growing industrial competition will put an ever greater squeeze on power-service costs.

■ As POWER's editors travel the field they see many signs that progressive engineers are gearing their plants to meet this new situation. Aware of the need for paring their costs with up-to-date equipment and methods, power men are tackling the job of modernizing with enthusiasm and ingenuity—and are reaping the benefits.

■ Here's a movement of great and timely importance to America's power-service systems, a movement we believe in and want to encourage and foster. As briefly announced in our 1953 Mid-September *Modern Plant Handbook*, we plan awards to fan growing interest in modernization, to stimulate ideas that will help all engineers to bring their plants up to date, and to recognize those who have already done outstanding jobs.

**YOUR OPPORTUNITY.** If you have completed a modernization job during the past two years (calendar 1952 and 1953), here is your opportunity to have your engineering skill and judgment recognized. Through the pages of POWER the results obtained in your plant will be made known to your fellow engineers across the country. And plants selected for outstanding accomplishment will receive a citation testifying to that fact—a citation that may be proudly displayed for all to see.

**WHO IS ELIGIBLE?** Entries may be made for any type of plant — steam, diesel or hydro — in any service — industry, institution or utility. Small installations will receive the same consideration as large.

Modernization may involve the entire power-service system or any major part of it—boiler plant, generating equipment, electrical distribution, heating, air-conditioning, refrigeration, compressed-air or water supply systems.

**BASIS OF JUDGING.** POWER's editors, assisted by advisory experts, will do the judging, putting emphasis on the gains resulting from modernization and on the ingenuity with which problems were solved and obstacles

# MODERNIZATION

overcome. Size and cost of installation will not influence judging; all will receive equal consideration.

**WHO MAY SUBMIT ENTRIES?** Most will come, of course, from power-service staffs, but consultants may enter for their clients. We will welcome suggestions and leads from anyone in the power field who knows of a meritorious modernization project.

**EASY TO ENTER.** To make it easy to tell us about what you've done, we've designed a simplified entry blank. By answering the streamlined questions on it, you can quickly give us the data we need about your program. For an idea of the kind of information wanted, and other pertinent details about entering, see the column at the right.

**ENTER NOW.** No matter how good a job you may have done, or how proud you may be of the results, you can't win an award for it unless you enter. So do it now. Then you'll have a chance to win concrete evidence of the worth of your accomplishments — recognition you, your top management and your staff will be proud of for years to come.

## How to submit entries

1. Entries will be received from plants of any type, of any size, in any service, in which a modernization program was completed during the calendar year 1952 or 1953. Modernization may cover the entire power-service installation or any major part of it.

2. Entries may be made by any responsible member of a plant's power-service staff, or by a consultant for his client.

3. To enter, just say "I'd like a 1954 Modernization Award blank" and address your card or note to:

Modernization Award Committee
% POWER
McGraw-Hill Publishing Co, Inc
330 West 42nd Street
New York 36, N. Y.

4. The entry blank you receive will contain a series of streamlined questions designed to make it easy for you to tell us about your modernization job and its results.

5. In general, the kind of information we ask for will tell us (1) what was modernized (2) the principal reasons for modernization (3) what results were obtained (4) the unique features of the job, and (5) what unusual or difficult problems were solved.

6. Entries will be received to May 15, 1954.

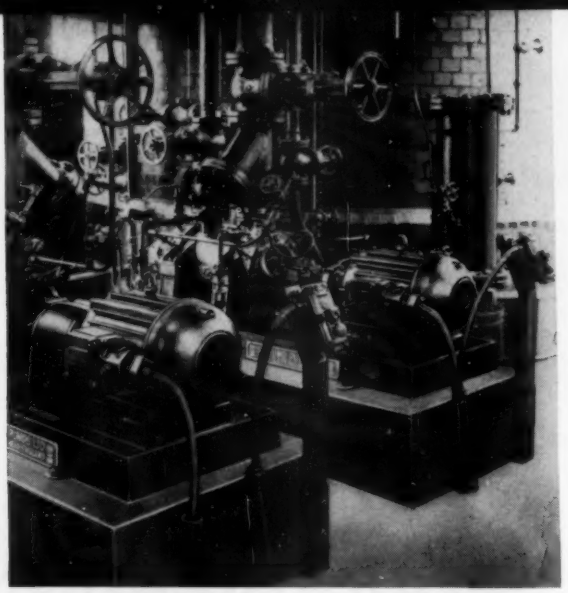
7. Announcement of award winners will be made in the 1954 Mid-September *Modern Plant Handbook* issue.

8. Arrangements for presentation of the awards will be made to suit the mutual convenience of the recipients and the POWER staff.

9. There is no set number of awards. It is our intention to recognize all plants that, in the opinion of the judges, have carried out modernizations of outstanding merit.

# Teamwork in Design And Installation Cut Snags in Pump Upkeep

By **M SIGMUND**, *Managing Director, Sigmund Pumps Ltd, Team Valley, Gateshead, England*



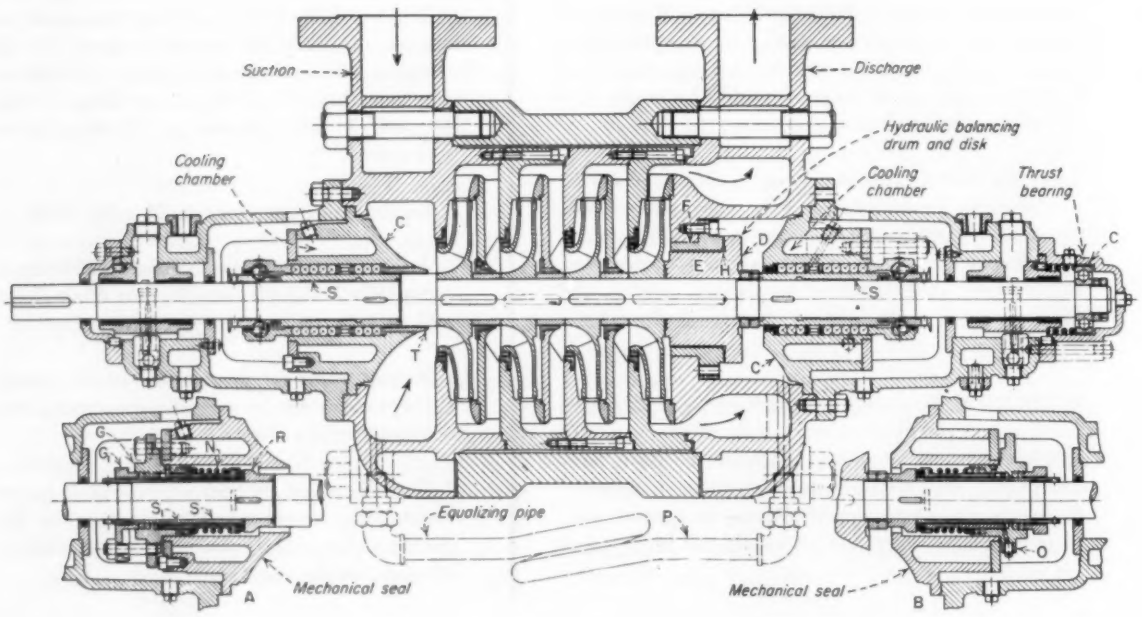
**MULTISTAGE BARREL-TYPE** pumps are used at Stanlow for many duties when pumping liquids at high temperatures, pressures

► WHEN Shell Chemical Manufacturing Co Ltd, Stanlow on the Manchester Ship Canal, England, planned its new chemical plant, the company's engineers met many pumping problems. An important one was pump maintenance. In addition, many different liquids had to be transferred from one part of the plant to another, or circulated through stills, tanks, columns and heat exchangers. All required special pumps.

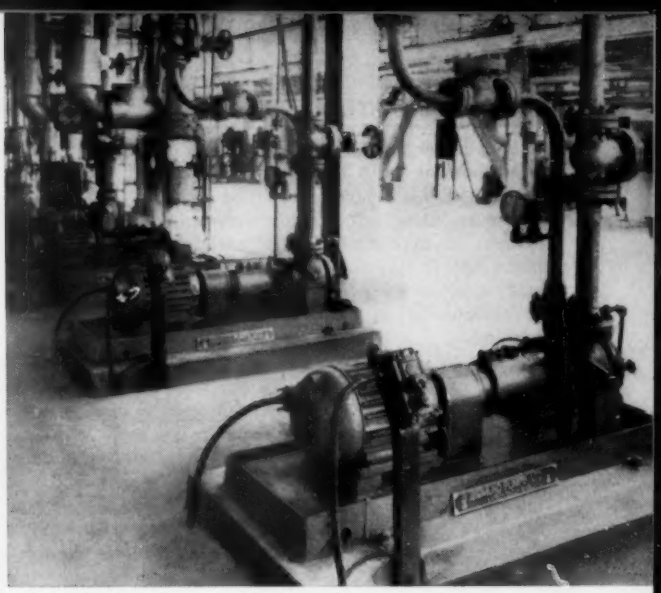
An initial study showed that more than 250 pumps were needed for process work. This number later increased to 552, all units being supplied by Sigmund Pumps Ltd. They handle almost all the pumping jobs in the new plant.

Pumping conditions at Stanlow vary widely. Some of the liquids are extremely volatile, others toxic; many are pumped at temperatures over 800 F. Some liquids handled are extremely expensive.

Usually, fluids pumped in this plant vary from light liquids (propane, butane) to heavy viscous fuels. These con-



**RING-CASING 2-STAGE** diffuser pumps at Stanlow have suction and discharge connections on opposite sides of the casing



**THESE PUMPS** have top-top suction and discharge, but casing and direction of rotation are same as for side-side pumps

ditions call for highly reliable pumps with shaft seals that keep leakage at a minimum.

**Spare Parts.** The large number of pumps to be installed created serious maintenance problems because it is expensive to stock a spare pump for each duty, as many oil refineries do at present. To deal with this situation, all pumping duties were tabulated and grouped according to services. This list showed it was possible to use three basic designs for all refinery services. These are a single-stage, a 2-stage (*below right*) and a multistage pump (*below left*).

To keep variations in parts to a minimum, designs were developed to use the same internal parts in all three pumps. Single-stage, 2-stage and multistage units have the same impellers and wearing rings. Only one bearing assembly is used in the single- and 2-stage pumps.

As a result, about one half the pumps use the same wearing rings, shaft sleeves and other wearing parts. Even some vertical sump pumps have interchangeable parts.

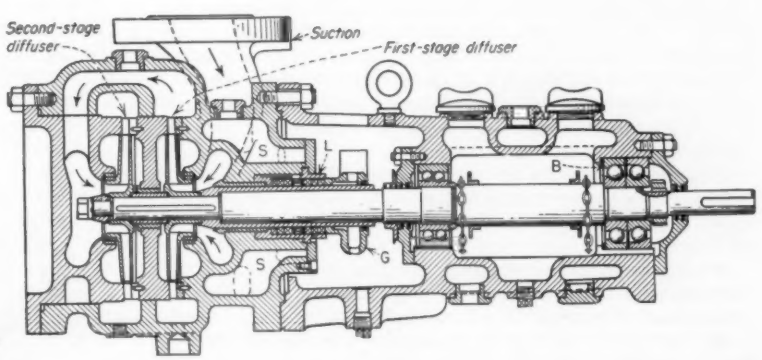
Only two impeller sizes are used in the pumps. They differ only in width, all other dimensions being the same. A second group has another size impeller and associated parts. This group has but one bearing assembly. More than 75% of all single- and 2-stage pumps in this refinery have but two bearing assemblies. This greatly simplifies maintenance problems by reducing the number of spare parts that must be stocked. Also, less capital is invested in spare parts.

**Diffuser Types.** Most of the pumps at Stanlow have a diffuser in a ring or a volute casing. This allows, after taking off the end cover, easy removal of the impeller and diffuser without breaking pipe connections. The suction is either horizontal left or right with the discharge opposite, or top-top, with an otherwise similar casing and direction of rotation.

Diffusers also largely eliminate the hydraulic radial thrust on the impeller and its shaft that exists in a simple volute casing. This thrust not only tends to deflect the shaft in one direction as it rotates, but also causes various states of deflection and vibration when pump output is controlled by throttling, which is done automatically during operation. Shaft deflection increases wear of the packing and of the shaft sleeves and makes the leakage along the shaft more difficult

**4-STAGE** barrel pump has all impellers facing in same direction, has a hydraulic balancing drum and disk. Stuffing-box pressure equals that on suction. Use either packing or mechanical seals in the pump

**INTAKE** of this 2-stage ring-casing diffuser-type centrifugal pump is at stuffing box to keep pressure on packing low and to wash away any solids entering with the liquid



to keep under control during operation of the pumping unit.

**Mechanical Seals.** All pumps at Stanlow are designed so mechanical seals can be installed in their packing space. After first using soft packing with rather elaborate sealing systems, mechanical seals were substituted for some of the more difficult duties. To further reduce gland leakage, all stuffing boxes are subjected to suction pressure only. This is accomplished by placing the pump intake at the stuffing-box end.

A design of this type tends to wash solids, like crystals or grit, away from the stuffing box instead of against it, as in pumps where the packing is subjected to discharge pressure. A cooling chamber around the packing and suction improves intake flow conditions when handling volatile or hot liquids.

**Seals Replace Packing.** Diagrams on pp 102, 3 show how a mechanical seal replaces the packing in these pumps. In the 2-stage units the packing space is reduced to desired size by a liner *L*. When this liner is removed there is ample radial space for installing a mechanical seal.

The eye of the first-stage impeller in this pump is next to the packing, while that of the second-stage faces the casing cover. Theoretically this arrangement keeps the pump in axial hydraulic balance. But any unbalanced thrust that may develop during operation is taken by a heavy, deep-groove, double ball bearing *B* on the outboard end of the shaft. The pump also has a cooling-liquid space *S* around its suction and a smothering or quenching gland *G* on the stuffing box.

**Multistage Pumps.** In the 4-stage high-pressure barrel-type pump, when packing is used, a thick sleeve *S* is placed on the shaft to fill the radial space not required by the packing. The packing space is in a separate cage *C* that can be removed along with the shaft sleeve *S* and throat bushing *T*. Then a ring carrying one of the sealing surfaces is installed on the shaft, as shown at *R*.

Next, a thin sleeve *S* is pressed on the shaft. Over this goes sleeve $S_1$ for the mechanical seal. This sleeve has a running clearance with the shaft. The other sealing surface is at its right-hand end. Seal assembly is held in place by gland *G*. Spring *N* holds the sealing surfaces in contact with one another. Gland *G* is sealed along the shaft by packing held in place by gland $G_1$. Any seal leakage may be bled off from back of the packing.

The mechanical-seal assembly for the discharge end of the pump is shown at *B*. This assembly is about the same as that at *A* for the suction end, except that the inner end of the casing is of a different form. A bleedoff between the packing and seal is shown at *O*, section *B*.

**Impeller Arrangement.** All impellers in the multistage pump face to the left. As a result there is an axial hydraulic thrust to the right. This is counteracted by a ball-thrust bearing at *C* and a hydraulic axial balancing disk *D*. Leakage from back of the last-stage impeller is along the clearance between drum *E* and ring *F* to an intermediate relief chamber at *H*. From here flow is radially between the drum and ring to hold these surfaces apart and the rotating element in axial hydraulic balance.

Discharge from the balancing disk flows back to the suction stage through pressure-equalizing pipe *P*. Suction pressure is, therefore, maintained on the packing or seal at both ends of the pump.

**Reactor Pump.** An interesting variation in design from those shown is that of a reactor pump for handling a troublesome sludge consisting of a light hydrocarbon and acid. Here a special sealing system was considered necessary, with injection and throttling clearances to keep the sealing liquid flow to a minimum.

Concentrated sulfuric acid is used for sealing; this requires that stuffing-box parts and bedplate be lead-lined. Because of the length of the overhung shaft, an internal bearing must be used. This can be done because the acid pumped, though extremely corrosive, is a good lubricant.

Special materials are used throughout the pump. The shaft-protecting sleeves and bearing bushings are faced with Colmonoy No. 6, an extremely hard and corrosion-resisting material.

**Barrel Pumps.** A number of services, where light hydrocarbons are pumped at high temperatures and pressures, use barrel pumps having three to eight stages. These have only two joints: One is under suction pressure, while the other is subjected to discharge pressure. This arrangement reduces possible leakage from a number of vertical casing joints to a minimum.

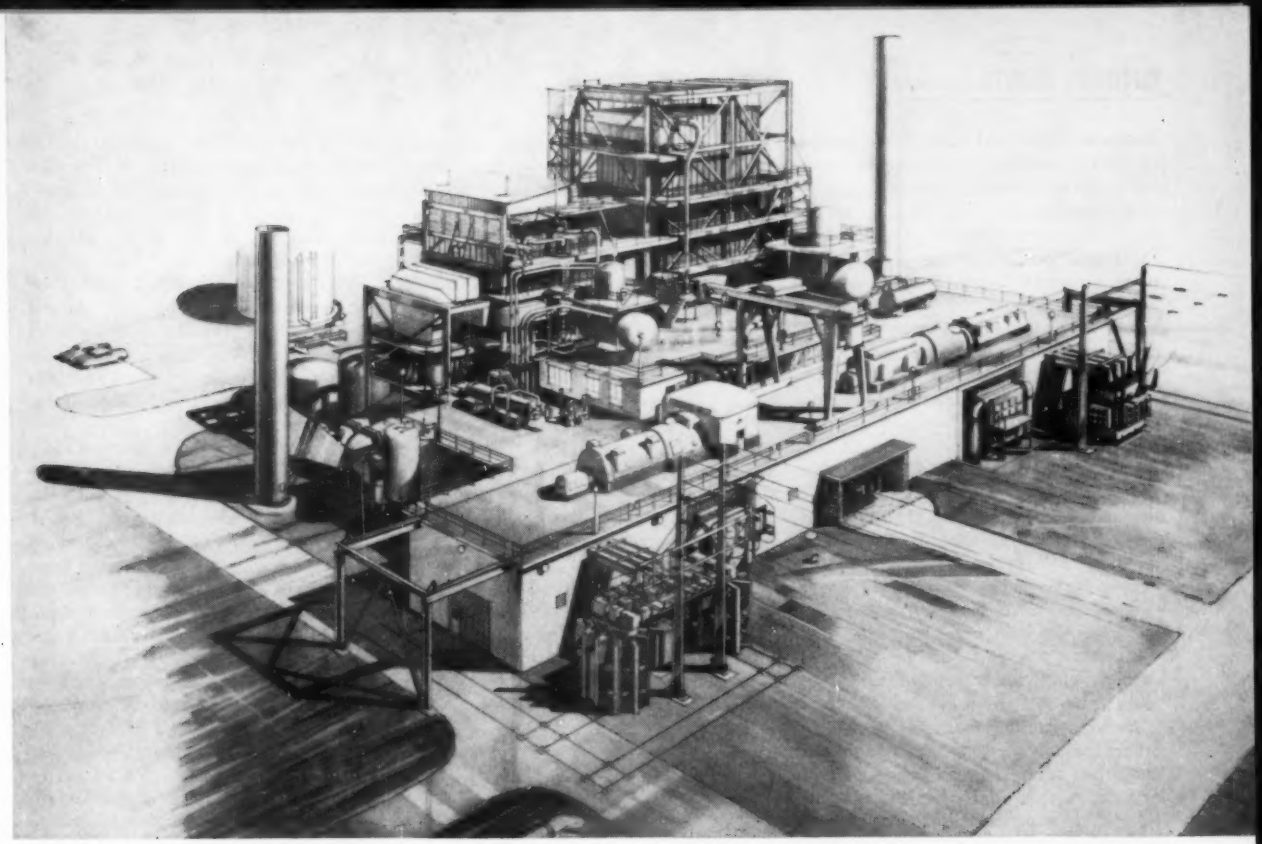
Stanlow is an excellent example of how close cooperation between the engineering staffs of a plant and a pump manufacturer solves knotty problems. The best maintenance program often proves inadequate when a plant is equipped with many different makes, sizes and types of pumps because so many procedures must be used. Also, the spare-parts stock may reach such proportions as to be unmanageable.

Success at Stanlow suggests that other processing plants try their program where a large number of pumps are needed.

## No. 2 of the Bill Eddy Cartoons

**Repeated by request**

**"Tsk, Tsk, Orville—Imagine, no limit switch!"**



**KYRENE STATION** of Salt River Power Dist has one 33,000-kw and one 66,000-kw turbine-generator. Curtain wall below turbine deck allows using indoor-type auxiliaries and drives. Control room, offices and boiler firing aisle stand on deck

# How Real Are Outdoor-Plant Savings?

**Jam-packed technical session at ASME annual meeting talks over the pros and cons of outdoor central-station design. Analysis by designers consistently shows reduced investment. Some maintenance delays and losses can offset net savings**

► RISING PRICES and rocketing capacities have continuously challenged central-station designers to seek ways of keeping costs down. Eliminating costly housing has offered one means of reducing investment. Its successful elimination, by certain process industries, and initial outdoor installations made as much as 20 years ago by some utilities, has led some engineering groups to regard these designs as conventional today.

Reduction in housing has been progressive over the years. Relatively few plants are completely outdoors today. But designers, in general, place some items of equipment outdoors, even in essentially indoor plants. Methods of reducing investment have not concentrated alone on building elimination but include other concurrent tricks, such as: (1) single boiler-per-turbine arrangements (2) elimination of cross connections and duplicate auxiliaries (3) condenser designs for low head room (4) centralized station controls (5) plant foundation slab laid at grade level without deep excavations (6) wall construction of lightweight materials without masonry.

**Power-plant housing** may do three jobs: (1) protect operating and maintenance personnel from inclement weather and cold (2) similarly shield equipment (3) give the plant a pleasing appearance to blend with the immediate surroundings. Owners of outdoor plants report that their operators and other station workers prefer the outdoor arrangement. The few months of inclement winter weather are gladly borne for the advantage of a cooler plant during the rest of the year.

The housing of an indoor plant protects the equipment from rain, snow, sleet, mist, fog, spray (on ocean shores), sand and dust storms, hurricanes, cloud bursts, extreme cold and floods. When the building is eliminated the equipment casing must provide this protection. In other words, getting rid of the building is not all clear gain. Increased casing costs of apparatus reduce the net saving. Erection of temporary shelter for construction crews during cold weather also reduces the net gain in outdoor-plant investment.

Acceptable appearance is largely a

matter of individual taste. Some groups feel that a building with suitable architectural treatment is the only answer to maintaining good will of plant neighbors. Outdoor proponents point out that functional designing and grouping of plant elements, together with selection of right materials, can give a pleasing appearance. Judicious selection of plant colors and attractive landscaping with ample ground space also help.

Experience with noise nuisance has varied. This usually becomes a problem only when the plant is in the vicinity of a residential area. One operator reported that his plant caused no noise nuisance even though no measures had been taken to soundproof the equipment. In his experience the buildings of indoor plants acted as sounding boxes to project the noise of all the equipment to the surroundings as a loud rumble. In contrast, the sound from outdoor equipment attenuates rapidly without amplification.

Noise reduction measures taken by others include enclosure and erection of acoustical barriers where needed. Plant orientation should be carefully considered to minimize the reflection and beaming of sound to neighboring areas where it may be objectionable. A buffer zone, where ample ground area permits, helps in noise control.

**Investment Savings.** Reduction in capital costs can only be estimated. The amount of the saving depends on equipment arrangement. This was brought out by F W Argue, Stone & Webster Engineering Corp, as shown in the bar charts on the facing page. Station 1 was designed and *built* as a totally enclosed plant with the exception of fans, dust collectors and chimneys. This 200,000-kw plant is coal fired and does not have completely centralized control. Station 2, on the other hand, was *built* as an outdoor plant with 250,000-kw capacity, fired by oil and gas, with completely centralized control. The chart shows how the incremental costs vary for each plan. The added costs are figured above that needed for outdoor arrangement.

In the *minimum-enclosure* plans operator comfort was provided only to the same extent as in outdoor plants, but major equipment was enclosed for protection and maintenance needs. In the *mild-climate enclosure* plants all enclosed space is treated as working area, suitably heated and ventilated for operator comfort. The *cold-climate enclosure* plants are the same as for a mild climate except that insulated wall construction is used. Incremental costs of enclosing each plant are:

| *Station* | *No. 1* | *No. 2* |
|---|---|---|
| Outdoor cost, million $..... | 22.5 | 26.2 |
| Minimum enclosure, add.. | 0.3% | 0.95% |
| Mild-clime enclosure, add.. | 1.8% | 2.15% |
| Cold-clime enclosure, add.. | 2.7% | 2.7% |

**Detailed estimates** for semi outdoor and outdoor savings and costs were given by E C Duffy, vice-president, Long Island Lighting Co, for four of his system plants. These are shown in Tables I to V, below. This company has adopted a policy of installing outdoor plants, the first in northeastern U.S. They have found their engineers and operators prefer the outdoor design because of improved comfort. The capital savings for the four plants, Table V, are estimated at over $4 per rated kw of capacity. This compares with a range of estimated savings of $3 to $7 per kw quoted by other utilities.

**Disadvantages.** POWER's survey of new plants, Jan 1954, pp 92-3, showed that only 38% of the new capacity being installed in 1953 to 1956 will have outdoor and semi-outdoor boilers, and only 21% will have similar turbine-generator arrangements.

E C Gaston, Southern Services, Inc, stated the case for indoor design followed by the Alabama Power Co, Georgia Power Co, Mississippi Power Co and Gulf Power Co. These combined hydro-steam systems usually have their lowest loads during the wet season, the first five months of the year. Their steam unit overhauls must be made during this time, so they find complete housing speeds up this work. Outage time of efficient units costs from $1000 to $3000 per day on these systems.

Widely fluctuating river levels require that their plants be placed partly below grade. This factor markedly reduces benefits available from outdoor design.

Average rainfall of about 60 in. per year in this region would be expected to prolong maintenance time in outdoor plants. The added cost must be capitalized and charged against the outdoor design.

Their current plant designs place i-d fans, dust collectors, recirculating fans, oil pumps, oil heaters, storage tanks, etc, outdoors at ground level. This helps

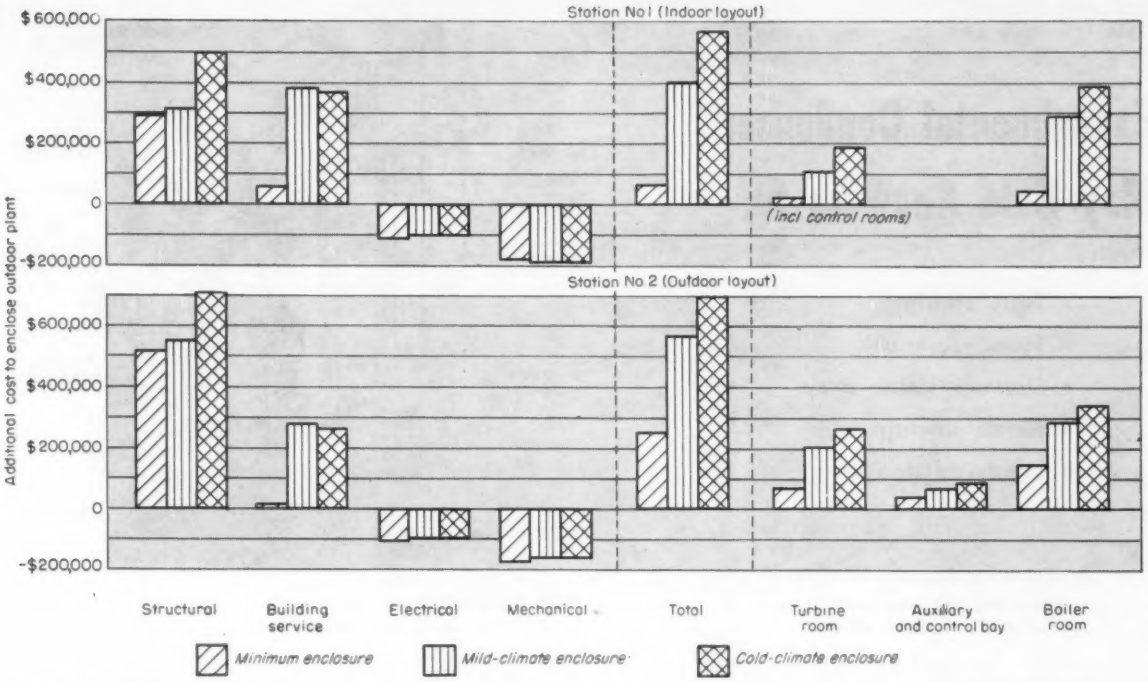
## Here's how Long Island Lighting...

### I: Estimated Reduction in Capital Costs With Semi-Outdoor Boiler Design (Thousands of dollars)

| Station | Port Jefferson | | Glenwood and Far Rockaway | | Glenwood | | Edward F Barrett | |
|---|---|---|---|---|---|---|---|---|
| Unit rating, megawatts | 40 | | 90 | | 90 | | 156 | |
| Starting date | 1948 and 1950 | | 1952 and 1953 | | 1954 | | 1956 | |
| | Semi-outdoor | Indoor | Semi-outdoor | Indoor | Semi-outdoor | Indoor | Semi-outdoor | Indoor |
| Substructure | 68.0 | 88.0 | 150.0 | 175.0 | 150.0 | 175.0 | 237.0 | 267.0 |
| Structural, miscellaneous steel | 70.0 | 141.0 | 161.0 | 242.0 | 161.0 | 242.0 | 255.0 | 355.0 |
| Corrugated siding, girts | 15.0 | – | 40.0 | – | 40.0 | – | 88.0 | – |
| Brick walls | 13.0 | 72.0 | 14.0 | 106.0 | 14.0 | 106.0 | 6.0 | 187.0 |
| Floors (differential) | – | 3.0 | – | 4.5 | – | 4.5 | – | – |
| Doors and windows | 10.0 | 28.0 | 12.0 | 30.0 | 12.0 | 30.0 | 8.0 | 34.0 |
| Roof | 5.0 | 9.0 | 8.0 | 12.0 | 11.0 | 12.0 | 8.0 | 16.0 |
| Painting and finishing | 14.0 | 19.0 | 18.0 | 23.0 | 18.0 | 23.0 | 21.0 | 27.0 |
| Heating and ventilating | 4.0 | 8.0 | 5.5 | 8.5 | 5.5 | 8.5 | 2.0 | 10.0 |
| Weatherproofing piping and ductwork | 3.0 | – | 5.0 | – | 5.0 | – | 5.0 | – |
| Flashing between boiler and concrete floors | 2.0 | – | 5.0 | – | 5.0 | – | 2.0 | – |
| Soot-blower covers and anti-freeze protection | 21.0 | – | 10.0 | – | – | – | – | – |
| Weatherproofing I-d fans and motors | – | – | – | – | – | – | 20.0 | – |
| Subtotals | 225.0 | 368.0 | 428.5 | 601.0 | 421.5 | 601.0 | 652.0 | 896.5 |
| Contingencies and overheads @ 25% | 56.2 | 92.0 | 107.1 | 150.2 | 105.4 | 150.2 | 163.0 | 224.1 |
| Total costs | 281.2 | 460.0 | 535.6 | 751.2 | 526.9 | 751.2 | 815.0 | 1,120.6 |
| Net savings per unit | 178.8 | – | 215.6 | – | 224.3 | – | 305.6 | – |

### II: Estimated Costs to Weatherproof Semi-Outdoor Boilers (Thousands of dollars)

| Station | Port Jefferson | Glenwood and Far Rockaway | Glenwood | Edward F Barrett |
|---|---|---|---|---|
| Unit rating, megawatts | 40 | 90 | 90 | 156 |
| Starting date | 1948 and 1950 | 1952 and 1953 | 1954 | 1956 |
| Corrugated asbestos siding and girts | 15.0 | 40.0 | 40.0 | 88.0 |
| Brick walls | 13.0 | 14.0 | 14.0 | 6.0 |
| Concrete floors for partial enclosures | –3.0 | –4.5 | 4.5 | – |
| Roof | 5.0 | 8.0 | 11.0 | 8.0 |
| Doors and windows | 10.0 | 12.0 | 12.0 | 8.0 |
| Flashing between boiler and concrete floor | 2.0 | 5.0 | 5.0 | 2.0 |
| Weatherproofing ducts and piping | 3.0 | 5.0 | 5.0 | 5.0 |
| Soot-blower covers and anti-freeze heating | 21.0 | 10.0 | – | – |
| Weatherproofing I-d fan inlet boxes and motors | | | | 20.0 |
| Subtotals | 66.0 | 89.5 | 82.5 | 137.0 |
| Contingencies, overhead @ 25% | 16.5 | 22.4 | 20.6 | 34.2 |
| Total cost per unit | 82.5 | 111.9 | 103.1 | 171.2 |




**OUTDOOR-PLANT SAVINGS** depend on basic-equipment arrangement used as reference point. Plant No. 1 has more compact arrangement typical of indoor plants. Plant No. 2 has arrangement of outdoor plant that usually covers more ground area

reduce building volume by partly adopting the outdoor idea. Using cheaper building materials, such as corrugated asbestos siding, further reduces the incentive to adopt outdoor design. The Southern Company System finds their plant costs compare favorably with the very lowest costs reported by other utilities regardless of the station type.

M K Drewry, Wisconsin Electric Power Co, also cited the advantage of using low-cost siding for indoor plants. He figured the additional heat loss from an outdoor boiler at ¾% more than an indoor boiler. Evaluating this heat loss he finds it equals 94% of the cost of a boiler enclosure. He sees no adequate inducement to take the long chance of making emergency repairs on an outdoor turbine in midwinter in their prevailing climate. If unfavorable weather prolongs outages an average of 1 1/3 days a year, the incremental cost for a building is more than paid for.

# ...estimates outdoor-design savings

## III: Estimated Reduction in Capital Costs With Outdoor Turbine-Generators (Thousands of dollars)

| Station | Glenwood and Far Rockaway | | Glenwood | | Edward F Barrett | |
|---|---|---|---|---|---|---|
| Unit rating, megawatts | 90 | | 90 | | 156 | |
| Starting date | 1952 and 1953 | | 1954 | | 1956 | |
| | Semi-outdoor | Indoor | Semi-outdoor | Indoor | Semi-outdoor | Indoor |
| Structural and miscellaneous steel | – | 40.0 | – | 40.0 | – | 70.0 |
| Roof, drains, flashing | 1.0 | 30.0 | 1.0 | 30.0 | 2.0 | 47.0 |
| Brick, glazed tile walls, windows | – | 80.0 | – | 80.0 | – | 144.0 |
| Heating and ventilating | – | 15.0 | – | 15.0 | – | 25.0 |
| Lighting | 3.0 | 5.0 | 3.0 | 5.0 | 4.0 | 6.5 |
| Painting | 8.0 | 13.0 | 8.0 | 13.0 | 10.0 | 16.0 |
| Walk-in enclosures at turbine front, exciter | 18.5 | – | 18.5 | – | 58.5 | – |
| Steel canopy for erection and maintenance | 6.5 | – | 6.5 | – | 7.5 | – |
| Turbine room crane | 77.0 | 60.0 | 77.0 | 60.0 | 142.0 | 117.0 |
| Snow melting system in turbine deck | 3.0 | – | – | – | – | – |
| Additional erection costs | 7.5 | – | 7.5 | – | 10.0 | – |
| Subtotal | 124.5 | 243.0 | 121.5 | 243.0 | 234.0 | 425.5 |
| Contingencies, etc, 25% | 31.1 | 60.8 | 30.4 | 60.8 | 56.0 | 106.4 |
| Totals | 155.6 | 303.8 | 151.9 | 303.8 | 290.0 | 531.9 |
| Net savings per unit | 148.2 | – | 151.9 | – | 241.9 | – |

## IV: Estimated Cost to Weatherproof Outdoor Turbine-Generators (Thousands of dollars)

| Station | Glenwood and Far Rockaway | Glenwood | Edward F Barrett |
|---|---|---|---|
| Unit rating, megawatts | 90 | 90 | 156 |
| Starting date | 1952 and 1953 | 1954 | 1956 |
| Walk-in enclosures | 18.5 | 18.5 | 58.5 |
| Steel canopy for erection and maintenance | 6.5 | 6.5 | 7.5 |
| Turbine-deck snow melting | 3.0 | – | – |
| Subtotals | 28.0 | 25.0 | 66.0 |
| Contingencies, etc, @ 25% | 7.0 | 6.3 | 16.5 |
| Total cost per unit | 35.0 | 31.3 | 82.5 |

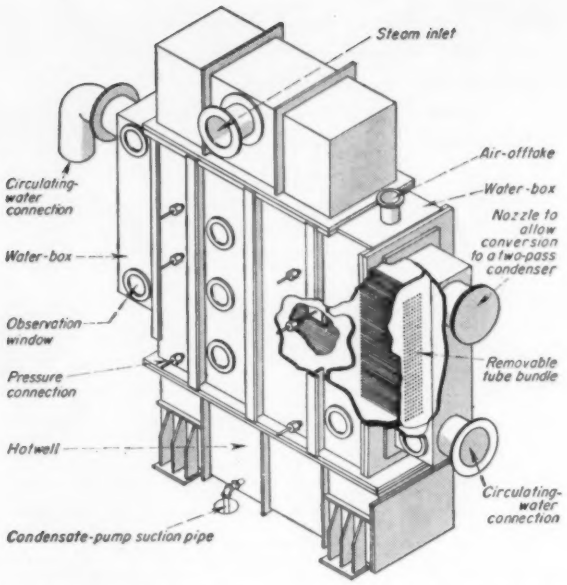
## V: Summary of Over-all Savings by Outdoor Design (Thousands of dollars)

| Station | Port Jefferson | Glenwood and Far Rockaway | Glenwood | Edward F Barrett |
|---|---|---|---|---|
| Unit rating, megawatts | 40 | 90 | 90 | 156 |
| Starting date | 1948 and 1950 | 1952 and 1953 | 1954 | 1956 |
| Semi-outdoor boiler | 178.8 | 215.6 | 224.3 | 305.6 |
| Outdoor turbine generator | – | 148.2 | 151.9 | 251.9 |
| Semi-outdoor coal silo | – | – | – | 27.5 |
| Outdoor coal-conveyor galleries | – | – | – | 56.2 |
| Outdoor circulating-water intake | – | – | – | 23.0 |
| Heating and ventilating reduction | – | – | – | 31.2 |
| Total savings per unit | 178.8 | 363.8 | 376.2 | 695.4 |
| Savings per kw rating | $4.47 | $4.04 | $4.18 | $4.45 |

# Experimental Condenser May Hold Answers to:

- Tube spacing
- Tube vibration
- Steam-pressure drop
- Baffle arrangement
- Improved design

By R A WILSON and H W FEIST
*Blower and Condenser Section*
*Allis-Chalmers Manufacturing Co*




**TEST CONDENSER** can simulate complete tube bank or part of full-sized unit; uses usual types of auxiliary equipment

► IS THERE A BETTER WAY to build a surface-type steam condenser? This question has challenged condenser-design engineers for decades. They have answered it by continuously developing improved designs. Modern surface condensers perform far better with less surface area than even the most visionary engineer expected not too long ago.

**Great design improvements** have been made in all types of power-plant equipment in our generation. The trends to higher steam temperatures and pressures and larger and larger individual units keep pace with the rapidly growing demands for electrical energy.

The future promises to be even more challenging, particularly in respect to atomic-power equipment. It is up to the condenser engineer to meet this challenge. By using a combination of basic research and data gathered from field tests he can keep needed improvements abreast of condenser service requirements.

In our company, basic research is taking the form of an experimental condenser with which fundamental design problems can be studied. Knowledge we expect to gain from it will be used to augment data from field tests, leading to improved commercial design.

**Picture above** shows the experimental surface condenser to be put in operation soon at Milwaukee, Wis. Although this model condenser does not look like the usual powerhouse unit, it contains the actual basic design. In addition, its arrangement can be varied widely to suit modifications for testing and studying proposed designs.

The greatest contribution to improved condenser design comes from actual field tests on existing units. Manufacturers continuously carry on a program of field test work and carefully tabulate the results. Unfortunately, it is seldom possible to test a condenser over broad ranges of load and cooling-water temperatures to get a comprehensive picture of performance. So the design engineer must depend on separate tests conducted in different parts of the country over a long period of time. Also, the problems of making any changes for test purposes, in condenser operating conditions in the typical large generating units, are becoming increasingly difficult because of the large blocks of power involved and consequent costs.

These field-test limitations prompted the decision to build the experimental condenser. With it, test data will be obtained much more quickly, and variables can be completely controlled and measured. We feel that the data obtained from the experimental unit will augment field-test data so that a much broader insight into good condenser design will result.

**Flexibility** is the keynote of the experimental condenser design. The entire tube bank can be removed to allow easy changes of tube materials, sizes, tube spacing and tube patterns. The cooling-water side can readily be arranged for one or more passes.

Internally the various baffles are quickly changed to suit different conditions. In general, the design allows a simulation of one complete tube bank or portion of a full-sized condenser. The many glass-covered portholes permit visual inspection and ready access to the inside of the condenser.

**Instrumentation** was very carefully planned. Pressure and temperature measuring locations at every critical point will give a complete picture of what is happening inside. Temperatures will be measured by calibrated thermometers immersed in oil. Absolute pressures will be indicated by a differential oil manometer many times more accurate than the usual mercury column.

The condenser will use the usual auxiliaries such as steam-jet air ejector, condensate pumps, circulating-water pump, etc. A series of nozzles meters the steam supplied to the condenser. This is checked by weighing the condensate as it leaves the condenser. An orifice measures the circulating-water flow and the inlet temperature is accurately controlled.

The experimental condenser will soon be put into initial operation. Among the problems to be studied will be: tube spacing and laning, tube vibration, pressure drop through the steam space, and baffling arrangements.

# Power's DATA SHEET

No. 260

| Pressure In. Hg. abs. (Sat. temp, F) | | Moisture, percent 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.5 | v | 1256.4 | 1234.8 | 1231.3 | 1218.7 | 1206.1 | 1193.6 | 1181.0 | 1168.5 | 1155.9 | 1143.3 | 1130.8 | 1118.2 | 1105.6 | 1093.1 | 1080.5 | 1067.9 |
| (58.8) | h | 1087.5 | 1076.9 | 1066.3 | 1055.7 | 1045.1 | 1034.5 | 1023.9 | 1013.3 | 1002.7 | 992.0 | 981.4 | 970.8 | 960.2 | 949.6 | 939.0 | 928.4 |
| | s | 2.0985 | 2.0780 | 2.0576 | 2.0371 | 2.0167 | 1.9962 | 1.9758 | 1.9553 | 1.9349 | 1.9144 | 1.8940 | 1.8735 | 1.8531 | 1.8326 | 1.8122 | 1.7917 |
| 1.0 | v | 652.3 | 645.8 | 639.3 | 632.7 | 626.2 | 619.7 | 613.2 | 606.6 | 600.1 | 593.6 | 587.1 | 580.5 | 574.0 | 567.5 | 561.0 | 554.5 |
| (79.0) | h | 1096.3 | 1085.8 | 1075.3 | 1064.8 | 1054.3 | 1043.8 | 1033.3 | 1022.9 | 1012.4 | 1001.9 | 991.4 | 980.9 | 970.4 | 959.9 | 949.4 | 938.9 |
| | s | 2.0387 | 2.0192 | 1.9998 | 1.9803 | 1.9608 | 1.9413 | 1.9219 | 1.9024 | 1.8829 | 1.8634 | 1.8440 | 1.8245 | 1.8050 | 1.7856 | 1.7661 | 1.7466 |
| 1.5 | v | 444.9 | 440.5 | 436.0 | 431.6 | 427.1 | 422.7 | 418.2 | 413.8 | 409.3 | 404.9 | 400.4 | 396.0 | 391.5 | 387.1 | 382.6 | 378.2 |
| (91.7) | h | 1101.7 | 1091.3 | 1080.8 | 1070.4 | 1060.0 | 1049.6 | 1039.2 | 1028.8 | 1018.3 | 1007.9 | 997.5 | 987.1 | 976.7 | 966.2 | 955.8 | 945.4 |
| | s | 2.0041 | 1.9852 | 1.9663 | 1.9474 | 1.9285 | 1.9096 | 1.8907 | 1.8718 | 1.8529 | 1.8341 | 1.8152 | 1.7963 | 1.7774 | 1.7585 | 1.7396 | 1.7207 |
| 2.0 | v | 339.2 | 335.8 | 332.4 | 329.0 | 325.6 | 322.2 | 318.8 | 315.5 | 312.1 | 308.7 | 305.3 | 301.9 | 298.5 | 295.1 | 291.7 | 288.3 |
| (101.1) | h | 1105.7 | 1095.3 | 1085.0 | 1074.6 | 1064.2 | 1053.9 | 1043.5 | 1033.1 | 1022.8 | 1012.4 | 1002.0 | 991.7 | 981.3 | 970.9 | 960.6 | 950.2 |
| | s | 1.9797 | 1.9612 | 1.9427 | 1.9243 | 1.9058 | 1.8873 | 1.8688 | 1.8503 | 1.8319 | 1.8134 | 1.7949 | 1.7764 | 1.7579 | 1.7394 | 1.7210 | 1.7025 |
| 2.5 | v | 274.9 | 272.2 | 269.4 | 266.7 | 263.9 | 261.2 | 258.4 | 255.7 | 252.9 | 250.2 | 247.4 | 244.7 | 241.9 | 239.2 | 236.4 | 233.7 |
| (108.7) | h | 1108.9 | 1098.6 | 1088.3 | 1077.9 | 1067.6 | 1057.3 | 1047.0 | 1036.6 | 1026.3 | 1016.0 | 1005.7 | 995.3 | 985.0 | 974.7 | 964.4 | 954.1 |
| | s | 1.9609 | 1.9427 | 1.9246 | 1.9064 | 1.8883 | 1.8701 | 1.8519 | 1.8338 | 1.8156 | 1.7975 | 1.7793 | 1.7611 | 1.7430 | 1.7248 | 1.7067 | 1.6885 |
| 3.0 | v | 231.6 | 229.3 | 227.0 | 224.7 | 222.3 | 220.0 | 217.7 | 215.4 | 213.1 | 210.8 | 208.4 | 206.1 | 203.8 | 201.5 | 199.2 | 196.9 |
| (115.1) | h | 1111.6 | 1101.3 | 1091.0 | 1080.7 | 1070.5 | 1060.2 | 1049.9 | 1039.6 | 1029.3 | 1019.0 | 1008.7 | 998.5 | 988.2 | 977.9 | 967.6 | 957.3 |
| | s | 1.9456 | 1.9277 | 1.9098 | 1.8919 | 1.8740 | 1.8561 | 1.8382 | 1.8203 | 1.8024 | 1.7845 | 1.7666 | 1.7487 | 1.7308 | 1.7130 | 1.6951 | 1.6772 |
| 4.0 | v | 176.7 | 174.9 | 173.2 | 171.4 | 169.6 | 167.9 | 166.1 | 164.3 | 162.6 | 160.8 | 159.0 | 157.3 | 155.5 | 153.7 | 152.0 | 150.2 |
| (125.4) | h | 1116.0 | 1105.8 | 1095.5 | 1085.3 | 1075.1 | 1064.9 | 1054.6 | 1044.4 | 1034.2 | 1024.0 | 1013.7 | 1003.5 | 993.3 | 983.0 | 972.8 | 962.6 |
| | s | 1.9214 | 1.9039 | 1.8864 | 1.8690 | 1.8515 | 1.8340 | 1.8165 | 1.7991 | 1.7816 | 1.7641 | 1.7466 | 1.7292 | 1.7117 | 1.6942 | 1.6767 | 1.6593 |
| Psia | | | | | | | | | | | | | | | | | |
| 0.5 | v | 641.4 | 635.0 | 628.6 | 622.2 | 615.7 | 609.3 | 602.9 | 596.5 | 590.1 | 583.7 | 577.3 | 570.8 | 564.4 | 558.0 | 551.6 | 545.2 |
| (79.6) | h | 1096.4 | 1085.9 | 1075.4 | 1064.9 | 1054.4 | 1044.0 | 1033.5 | 1023.0 | 1012.5 | 1002.0 | 991.5 | 981.0 | 970.5 | 960.1 | 949.6 | 939.1 |
| | s | 2.0372 | 2.0178 | 1.9983 | 1.9789 | 1.9594 | 1.9400 | 1.9205 | 1.9011 | 1.8816 | 1.8622 | 1.8427 | 1.8233 | 1.8038 | 1.7844 | 1.7649 | 1.7455 |
| 1.0 | v | 333.6 | 330.3 | 326.9 | 323.6 | 320.3 | 316.9 | 313.6 | 310.2 | 306.9 | 303.6 | 300.2 | 296.9 | 293.6 | 290.2 | 286.9 | 283.6 |
| (101.7) | h | 1106.0 | 1095.6 | 1085.3 | 1074.9 | 1064.5 | 1054.2 | 1043.8 | 1033.5 | 1023.1 | 1012.7 | 1002.4 | 992.0 | 981.6 | 971.3 | 960.9 | 950.6 |
| | s | 1.9782 | 1.9597 | 1.9413 | 1.9228 | 1.9044 | 1.8859 | 1.8675 | 1.8490 | 1.8306 | 1.8121 | 1.7936 | 1.7752 | 1.7567 | 1.7383 | 1.7198 | 1.7014 |
| 1.5 | v | 228.7 | 226.4 | 224.1 | 221.8 | 219.6 | 217.3 | 215.0 | 212.7 | 210.4 | 208.1 | 205.8 | 203.5 | 201.3 | 199.0 | 196.7 | 194.4 |
| (115.7) | h | 1111.8 | 1101.5 | 1091.2 | 1081.0 | 1070.7 | 1060.4 | 1050.1 | 1039.8 | 1029.5 | 1019.3 | 1009.0 | 998.7 | 988.4 | 978.1 | 967.8 | 957.6 |
| | s | 1.9442 | 1.9263 | 1.9085 | 1.8906 | 1.8727 | 1.8548 | 1.8370 | 1.8191 | 1.8012 | 1.7833 | 1.7655 | 1.7476 | 1.7297 | 1.7119 | 1.6940 | 1.6761 |
| 2.0 | v | 173.7 | 172.0 | 170.3 | 168.5 | 166.8 | 165.0 | 163.3 | 161.6 | 159.8 | 158.1 | 156.4 | 154.6 | 152.9 | 151.1 | 149.4 | 147.7 |
| (126.1) | h | 1116.2 | 1106.0 | 1095.8 | 1085.5 | 1075.3 | 1065.1 | 1054.9 | 1044.6 | 1034.4 | 1024.2 | 1014.0 | 1003.8 | 993.5 | 983.3 | 973.1 | 962.9 |
| | s | 1.9200 | 1.9025 | 1.8851 | 1.8676 | 1.8502 | 1.8327 | 1.8153 | 1.7978 | 1.7804 | 1.7629 | 1.7455 | 1.7280 | 1.7106 | 1.6931 | 1.6757 | 1.6582 |
| 2.5 | v | 141.1 | 139.7 | 138.3 | 136.8 | 135.4 | 134.0 | 132.6 | 131.2 | 129.8 | 128.4 | 127.0 | 125.6 | 124.2 | 122.7 | 121.3 | 119.9 |
| (134.4) | h | 1119.7 | 1109.5 | 1099.4 | 1089.2 | 1079.0 | 1068.8 | 1058.7 | 1048.5 | 1038.3 | 1028.1 | 1018.0 | 1007.8 | 997.6 | 987.4 | 977.3 | 967.1 |
| | s | 1.9014 | 1.8843 | 1.8672 | 1.8500 | 1.8329 | 1.8158 | 1.7987 | 1.7815 | 1.7644 | 1.7473 | 1.7302 | 1.7130 | 1.6959 | 1.6788 | 1.6617 | 1.6445 |
| 3.0 | v | 118.7 | 117.5 | 116.3 | 115.1 | 114.0 | 112.8 | 111.6 | 110.4 | 109.2 | 108.0 | 106.8 | 105.7 | 104.5 | 103.3 | 102.1 | 100.9 |
| (141.5) | h | 1122.6 | 1112.5 | 1102.3 | 1092.2 | 1082.1 | 1071.9 | 1061.8 | 1051.7 | 1041.5 | 1031.4 | 1021.3 | 1011.1 | 1001.0 | 990.9 | 980.8 | 970.6 |
| | s | 1.8863 | 1.8694 | 1.8526 | 1.8357 | 1.8189 | 1.8020 | 1.7852 | 1.7683 | 1.7515 | 1.7346 | 1.7178 | 1.7009 | 1.6840 | 1.6672 | 1.6503 | 1.6335 |
| 3.5 | v | 102.7 | 101.7 | 100.7 | 99.63 | 98.61 | 97.58 | 96.56 | 95.53 | 94.50 | 93.48 | 92.45 | 91.42 | 90.39 | 89.37 | 88.34 | 87.31 |
| (147.6) | h | 1125.1 | 1115.0 | 1104.9 | 1094.8 | 1084.8 | 1074.6 | 1064.5 | 1054.4 | 1044.3 | 1034.2 | 1024.1 | 1014.0 | 1003.9 | 993.9 | 983.8 | 973.7 |
| | s | 1.8735 | 1.8569 | 1.8402 | 1.8236 | 1.8070 | 1.7904 | 1.7737 | 1.7571 | 1.7405 | 1.7239 | 1.7072 | 1.6906 | 1.6740 | 1.6574 | 1.6407 | 1.6241 |
| 4.0 | v | 90.63 | 89.72 | 88.82 | 87.91 | 87.00 | 86.10 | 85.19 | 84.29 | 83.38 | 82.47 | 81.57 | 80.66 | 79.75 | 78.85 | 77.94 | 77.04 |
| (153.0) | h | 1127.3 | 1117.2 | 1107.2 | 1097.1 | 1087.0 | 1077.0 | 1066.9 | 1056.9 | 1046.8 | 1036.7 | 1026.7 | 1016.6 | 1006.5 | 996.5 | 986.4 | 976.3 |
| | s | 1.8625 | 1.8461 | 1.8296 | 1.8132 | 1.7968 | 1.7804 | 1.7639 | 1.7475 | 1.7311 | 1.7147 | 1.6982 | 1.6818 | 1.6654 | 1.6489 | 1.6325 | 1.6161 |
| 4.5 | v | 81.16 | 80.35 | 79.54 | 78.73 | 77.91 | 77.10 | 76.29 | 75.48 | 74.67 | 73.86 | 73.04 | 72.23 | 71.42 | 70.61 | 69.80 | 68.99 |
| (157.8) | h | 1129.3 | 1119.3 | 1109.2 | 1099.2 | 1089.2 | 1079.1 | 1069.1 | 1059.0 | 1049.0 | 1039.0 | 1028.9 | 1018.9 | 1008.9 | 998.8 | 988.8 | 978.8 |
| | s | 1.8528 | 1.8365 | 1.8203 | 1.8040 | 1.7878 | 1.7715 | 1.7553 | 1.7390 | 1.7228 | 1.7065 | 1.6903 | 1.6740 | 1.6578 | 1.6415 | 1.6253 | 1.6090 |
| 5.0 | v | 73.52 | 72.78 | 72.05 | 71.31 | 70.58 | 69.84 | 69.11 | 68.37 | 67.64 | 66.90 | 66.17 | 65.43 | 64.70 | 63.96 | 63.23 | 62.49 |
| (162.2) | h | 1131.1 | 1121.1 | 1111.1 | 1101.1 | 1091.1 | 1081.1 | 1071.0 | 1061.0 | 1051.0 | 1041.0 | 1031.0 | 1021.0 | 1011.0 | 1001.0 | 991.0 | 981.0 |
| | s | 1.8441 | 1.8280 | 1.8119 | 1.7958 | 1.7797 | 1.7636 | 1.7475 | 1.7314 | 1.7153 | 1.6993 | 1.6832 | 1.6671 | 1.6510 | 1.6349 | 1.6188 | 1.6027 |
| 5.5 | v | 67.24 | 66.57 | 65.90 | 65.22 | 64.55 | 63.88 | 63.21 | 62.53 | 61.86 | 61.19 | 60.52 | 59.84 | 59.17 | 58.50 | 57.83 | 57.15 |
| (166.3) | h | 1132.7 | 1122.7 | 1112.7 | 1102.7 | 1092.8 | 1082.8 | 1072.8 | 1062.8 | 1052.8 | 1042.8 | 1032.9 | 1022.9 | 1012.9 | 1002.9 | 992.9 | 982.9 |
| | s | 1.8363 | 1.8203 | 1.8044 | 1.7884 | 1.7725 | 1.7565 | 1.7406 | 1.7246 | 1.7087 | 1.6927 | 1.6768 | 1.6608 | 1.6449 | 1.6289 | 1.6130 | 1.6289 |
| 6.0 | v | 61.98 | 61.36 | 60.74 | 60.12 | 59.50 | 58.88 | 58.26 | 57.64 | 57.02 | 56.40 | 55.78 | 55.16 | 54.54 | 53.92 | 53.30 | 52.68 |
| (170.1) | h | 1134.2 | 1124.2 | 1114.3 | 1104.3 | 1094.4 | 1084.4 | 1074.4 | 1064.5 | 1054.5 | 1044.5 | 1034.6 | 1024.6 | 1014.7 | 1004.7 | 994.7 | 984.8 |
| | s | 1.8292 | 1.8134 | 1.7976 | 1.7817 | 1.7659 | 1.7501 | 1.7343 | 1.7185 | 1.7026 | 1.6868 | 1.6710 | 1.6552 | 1.6394 | 1.6235 | 1.6077 | 1.5919 |

## Thermodynamic Table Of Wet Steam—I

► THIS TABLE will speed up calculations in the wet-steam region. It is laid out in a fashion similar to the superheat tables in the Keenan & Keyes steam tables. Columns are arranged against percent moisture of saturated mixture.

Symbols are: $v$ = specific volume, cu ft per lb; $h$ = enthalpy, Btu per lb; $s$ = entropy, Btu per F per lb. Proportional interpolation between listed quantities determines intermediate state properties.

This table runs from 0 to 15% moisture, next month's table will run from 15 to 30%. The two cover the region most used in practical applications.

B G A SKROTZKI, *Associate Editor*

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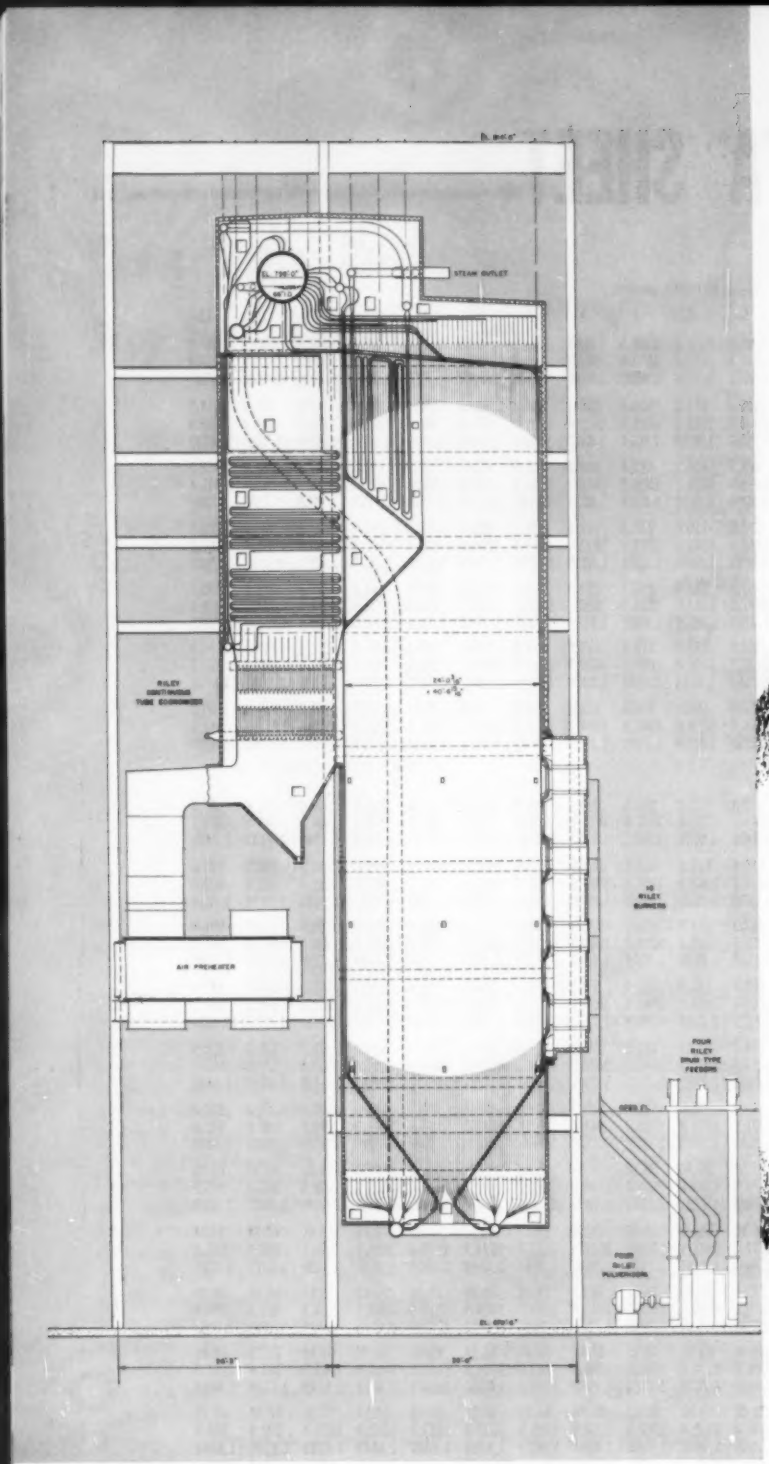

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85,000 B.T.U. per sq. ft. of furnace envelope

Furnace Width—40'7"
Furnace Depth—24'0 3/8"
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Commonwealth Associates, Inc., Engineers

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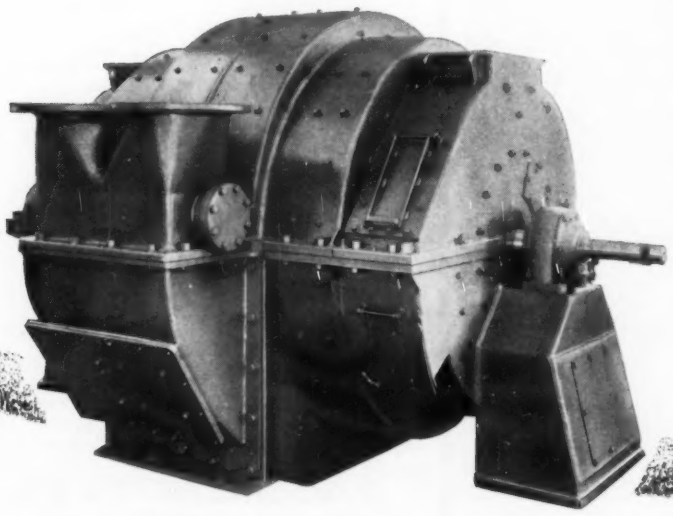

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2075 psig, 1000°F., 1000° Reheat

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**The Potomac Edison Co.**
2—700,000 lbs./hr. 1050 psig, 905°F.
Sanderson & Porter, Engineers

**Southwestern Gas & Electric Co.**
630,000 lbs./hr. 1025 psig, 1005°F.—Pressurized Furnace
Sargent & Lundy, Engineers

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620,000 lbs./hr. 1500 psig, 955°F.
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**Arkansas Power & Light Co.**
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Ebasco Services, Inc., Engineers

**Gulf Power Company**
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Southern Services, Engineers

**Iowa-Illinois Gas & Electric Co.**
250,000 lbs./hr., 975 psig, 905°F.

**Ohio Edison Co.**
225,000 lbs./hr., 975 psig, 900°F.
Commonwealth Services, Engineers

**Mississippi Power Co.**
230,000 lbs./hr., 925 psig, 850°F.
Southern Services, Engineers

**Interstate Power Co.**
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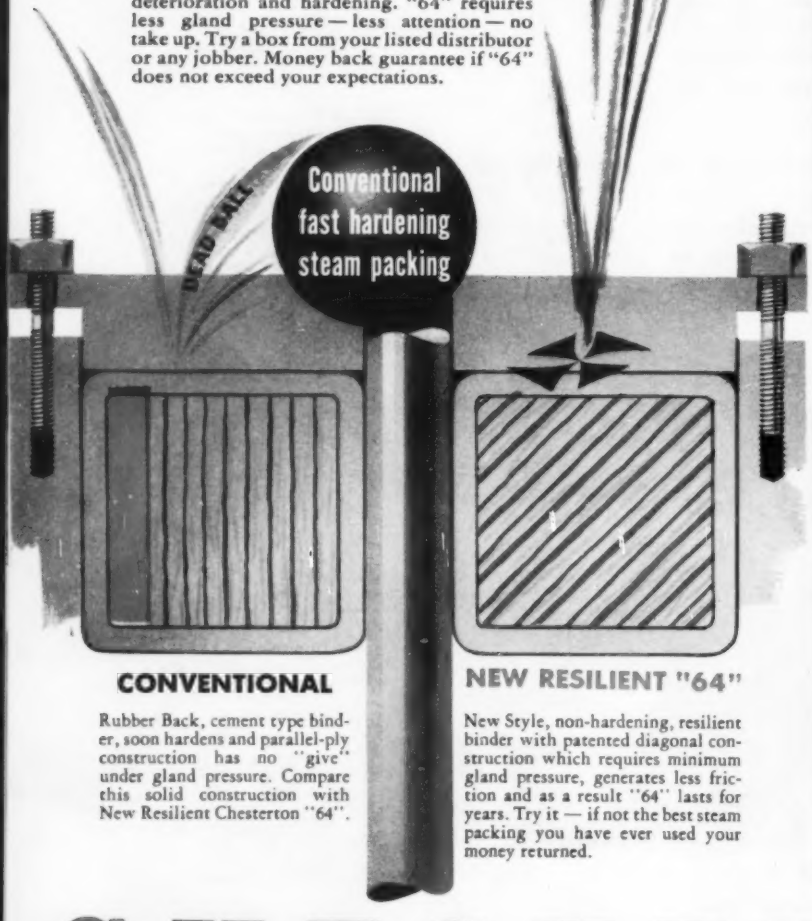


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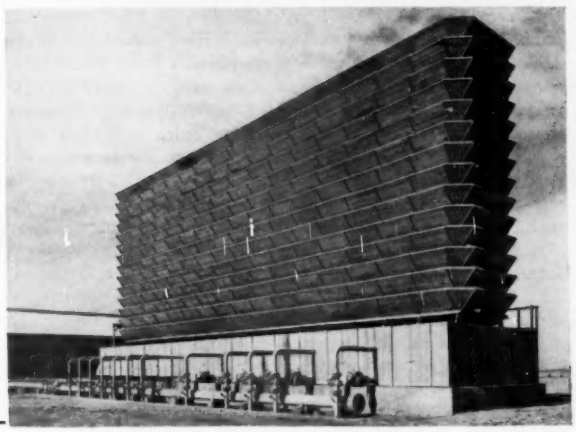
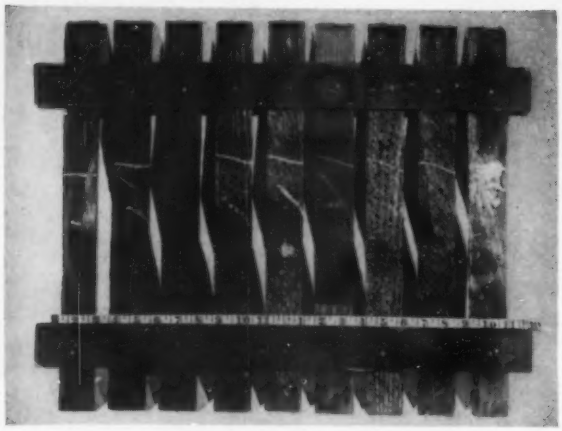


# How Smart Care Keeps Cooling Towers Working

Based on *Cooling Tower Wood Maintenance*, a report by the Cooling Tower Institute ▶



**1** One of the many wood test panels installed in 20 towers in the Gulf Coast area. Each panel has nine wood samples

## History and scope

► EARLY IN 1950, several redwood suppliers and cooling-tower manufacturers were advised that rapid and serious deterioration was occurring in redwood cooling towers in the Gulf Coast area. Examination of wood samples from the towers showed that there were different types of deterioration. Reports from tower users confirmed the sample studies. Also, it was apparent that causes involved were not obvious.

**First Reports.** Gradual breakdown and ultimate failure of redwood in cooling towers have long been recognized. Cases of moderate deterioration were reported as early as 1948. But instances of extremely rapid deterioration were not brought to the general attention of the industry until 1950.

To analyze the problem and develop a program for its solution, representatives of the Cooling Tower Institute and California Redwood Association met in July 1950. They immediately saw that reaching a solution was a long-range project. Full cooperation between lumber suppliers, tower manu-

## Types of deterioration

Although seven types of deteriorated wood were analyzed for this study, they are arbitrarily defined here in two major categories—surface and interior deterioration.

**Surface Attack.** This occurs on the surface of the wood and may be of two types. Chemical action, Fig. 2 and 3, is probably entirely of chemical origin. It produces a white fibrous surface on the wood. During the early stages, Fig. 2, the sound internal wood structure remains intact. White surface shows that selective removal of lignin and extractives has occurred.

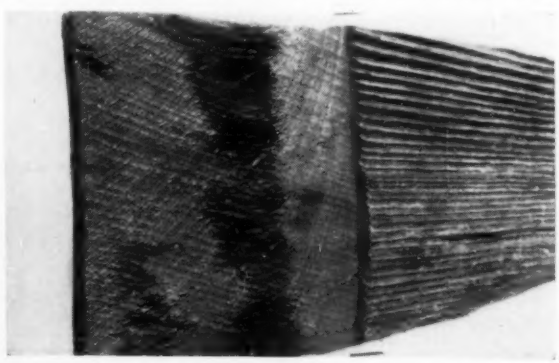
Fig. 3 shows another example of surface chemical action. This sample is from an air-inlet louver of a tower in an area exposed to air-borne fumes from an acid plant. After 10 years of continuous service in a completely dry position in the tower the wood surface is broken down in such a way that numerous long reddish-brown threads are formed and partially separated. This sample is not typical of the condition but is shown to indicate one of the unusual forms of surface attack on cooling-tower wood.

Biological action is the second type of surface deterioration. It may be preceded by chemical action, and can be identified by a brash, crumbly surface condition, Fig. 4. The surface of the wood in Fig. 4 is easily scraped off with a small nail.

**Internal Attack.** When attack occurs internally in the wood it is usually the result of fungal action. It is probably preceded by chemical degradations similar to those in surface attack. The result is a brash, delaminated or crumbly condition in the interior of the wood, Fig. 5. Wood surface remains sound but inside is soft degraded wood. Probing with an ice pick or sharp knife will usually expose this fungal-action decay. Now let's take a closer look at types of deterioration.

**Chemical Surface Attack.** This leaves a coating of white fibers on the wood surface. You can recognize it both by the color and the finely divided fibrous texture. But color alone is not the only indication because thin scales of salts often produce a white coating. The distinctive fibrous surface must be seen to classify the deterioration as chemical surface attack.

**2** Early stages of chemical attack of the white fibrous-surface type in which internal wood structure remains intact



**5** Internal biological deterioration showing the relatively sound exterior surfaces and soft degraded internal wood

Chemical analysis of this type of attack shows that more lignin is removed than any other single component of the wood. Next in order was the extractive content; after this the cellulose.

The possibility of this condition being the result of organic action was considered. Fungi are known that remove lignin selectively, and they have been found in wood specimens from

facturers and users was needed. A later meeting with tower users in Houston showed they were ready to work together to clear up the troubles.

This report is a summary of the work done and conclusions reached to date as a result of this joint study.

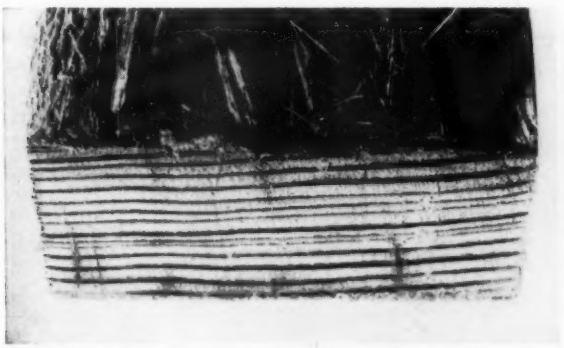
**Scope.** Deterioration studies and conclusions given in this article are based on, and limited to, a statistical analysis of data from 103 operating cooling towers in the Gulf Coast area. They are in the area extending from Brownsville, Texas to Baton Rouge, La. They include all commercially available types and designs ranging in age from a few months to 22 years. They are confined to what is usually considered industrial-tower size. In some instances the discussion and conclusions are supplemented by general knowledge of towers.

Our studies have been under way for about two years and the scope of this report is limited to analysis of data obtained during the summer of 1951. So remember that the amount of information is limited and that the conclusions drawn from it are tentative. As more and better data are secured in future studies the conclusions here may be refined or revised. But much can be learned from the results that are given here.

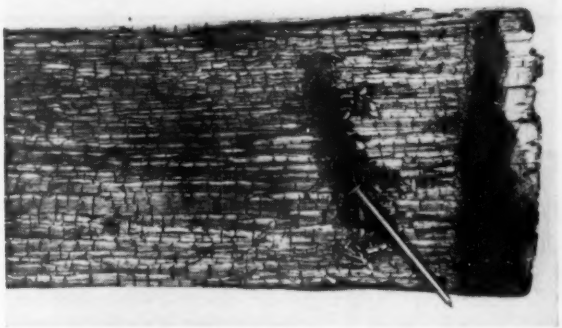
**Besides examination** of data and samples from 103 towers, treated-wood test panels, Fig. 1, have been installed in 20 selected towers in the Gulf Coast area. These panels contain various woods treated with several chemical agents that are thought to offer some means of reducing deterioration.

Of the nine pieces of wood in the panel, Fig. 1, four species are used. Each is treated differently, or is untreated for control purposes. Redwood, fir, pine and cedar are under test in the panels. A total of 360 test pieces in 9-piece panels are distributed throughout each of the 20 test towers. Since results from this test program are necessarily long range, this report does not include any conclusions derived from study of the panels.

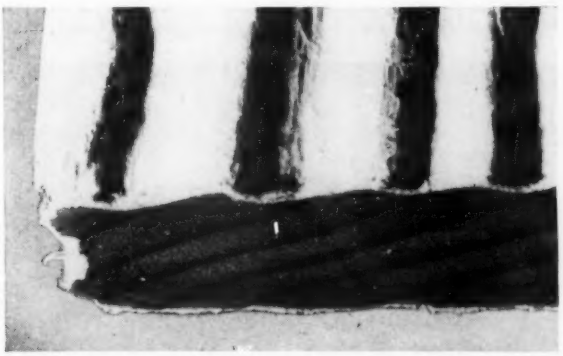
The widespread use of California heart redwood continues to indicate that this material successfully withstands the test of time and remains the best of the commercially available species for cooling-tower applications. The impression of "failure" results only from severe instances of rapid degradation that have been spotlighted for thorough study.



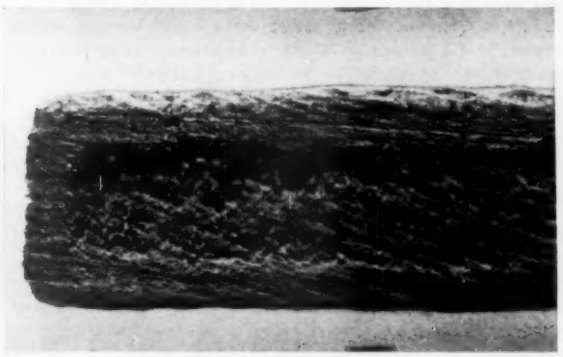
**3** Surface chemical action showing acid-degraded wood as removed from the air-inlet louvers of a 10-yr-old tower



**4** Early stage of surface biological deterioration. This is a sample from a system having a pH of 8-8.8. Note brash



**6** Deck batt from flooded area of tower showing the surface chemical attack in which the delignified wood is ridged



**7** Eliminator batt with internal biological attack after seven years' service in a system with 7.4 pH, 0.1 ppm Cl

cooling towers. But they are not known to produce the usual appearance of this form of deterioration. These fungi usually operate in small pockets, leaving a cellulose residual. No cases are known in which they leave a deep bed of cellulose fibers over an entire surface, as is shown by typical examples of this type of deterioration. More likely, this type is of chemical origin. A certain amount of this attack is unavoidable because cooling-tower waters have a leaching action that appears to increase with higher pH values (greater alkalinity).

**Wood Chemistry.** A review of this subject shows that lignin can be removed by treatment with a highly alkaline solution. It is also known that lignin may be removed selectively by oxidizing agents. Also, alternate treatment with alkaline solu-

tions and an oxidizing agent produces rapid lignin degradation. The pH of circulating water in cooling towers is usually not high enough for the solution to be strongly alkaline. Chlorine is the principal oxidizing agent present, but usually its concentration is not sufficient to produce rapid lignin removal.

**Time Factors.** In cooling-tower operation extremely long periods of time are involved. Reactions need not be rapid to produce an end result. Chemical attack becomes particularly severe with high-pH circulating water where the surface concentrations of alkaline materials are likely to be high.

More support for this belief comes from tower operators who report that this condition can be rapidly produced by increasing chlorine residuals, showing that careful control is necessary. Also, the condition becomes extremely severe if chlorine residuals above 1 ppm are maintained in waters with a high pH. It is important to remember that the toxic extractives normally in redwood that render it resistant to decay are reduced by this type of degradation since it has a bearing on biological surface attack.

Chemical deterioration is closely related to the composition of the water and the probability of attack may be predicted from analysis of the water. It appears that this type of attack is highest in the parts of the tower contacting flowing water and in air-inlet areas in which drops of water splashing out onto louvers evaporate completely to a dry condition.

Drying of these drops mechanically disintegrates the wood as crystals form beneath the surface, Fig. 6. In this sample delignified wood shows a ridged surface, bleached and whitened after 12 years' continuous service. Adequate strength remains in the unaffected wood.

**Biological Surface Attack.** This form produces a crumbly surface on the wood, not unlike the residues of the brown rots. It is probably preceded by chemical degradation. You can usually recognize it by the finely divided crumbly texture of the wood. But color alone is not sufficient for detecting type of attack. Certain water contaminants like oil produce a brown color too.

Surface texture and brashness of the wood should receive study. Chemical analysis of this type of deterioration shows that cellulose has been removed selectively. Extractive content has also been reduced to about the same level found in chemical surface attack. This type of attack could not be positively qualified as solely chemical in effect because study of numerous water analyses failed to show any chemical conditions that would remove cellulose selectively.

**Samples** of brash lumber with this type of deterioration were taken from several towers in one plant and cultured,

## Operation and Maintenance

Now let's take a quick look at operating conditions that affect deterioration of the types described above. The study permits some valuable conclusions on operating practices. Here are a number of factors to keep your eye on during operation and maintenance of industrial cooling towers.

**Tower Design.** Both types of surface and internal attack appear in all designs of towers. The attack was at the same general level of intensity. No major differences were found between average deterioration rates for different designs.

**Plant Served by Tower.** All types of attack have been found in towers serving the petroleum-refining, chemical and utilities industries. No relationship between type of attack and type of service appeared in this study.

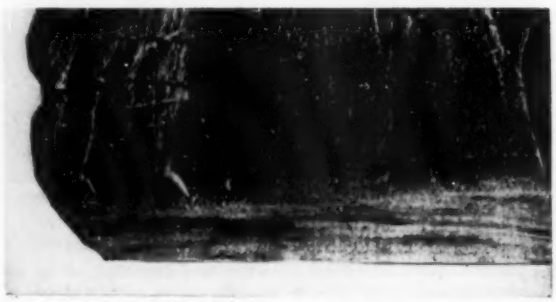
**Tower Age.** Extent of surface attack and tower age do not follow a straight-line relationship. Data show the rate of deterioration per year is highest in new towers and tends to decrease with age. A layer of degraded wood on the surface may retard further degradation, particularly chemical surface attack. The degraded wood forms a protective coating over the unaffected wood. This reduces further attack.

Biological attack, where it appears at all, shows about a straight-line relationship with age, Fig. 8-10.

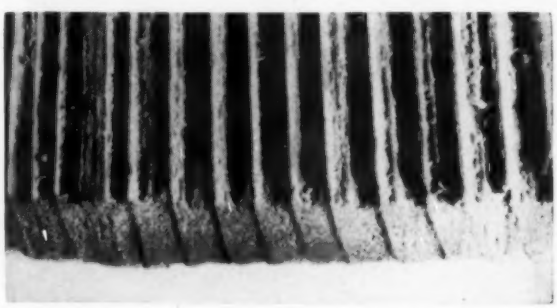
**Water, Wood Temperature.** Rate of surface attack increases as inlet-water temperature rises. Internal attack, in the areas where it occurs, shows a close correlation to the wood temperature. This attack is generally confined to wood at temperatures of 88 to 105 F. In the geographical area studied, surface attack appears limited almost exclusively to the inlet-water temperature range of 103 to 120 F.

**Circulating-Water pH.** Chemical attack increases with a rise in pH. Remember that deterioration rate depends on the chemical constituents fixing the pH, along with the influence of other variables in the system. Minimum deterioration occurs in a pH range of 7 to 7.5, Fig. 11.

**Algaecides.** Chlorine was the only treatment used in enough towers to permit estimating the relation between



**8** Relatively mild intensity of surface biological attack is shown by this sample from a tower in Gulf Coast area



**11** Eliminator batt showing fuzzy external condition, the result of surface chemical degradation after 10 years

then the cultures were purified and studied. A number of bacteria and fungi were isolated. All were checked for their ability to utilize cellulose as their sole source of carbon. None of the bacteria was able to do so but a number of the fungi showed they could take their carbon from cellulose.

Transplanting these fungi to redwood showed that a considerable number could live by using this wood as their sole source of carbon. Since no chemicals that might remove cellulose selectively were known to be present, and since the fungi present could attack redwood, it is believed that this type of deterioration represents the end result of fungal action. But the detailed mechanism or the organisms mainly responsible have not, as yet, been established.

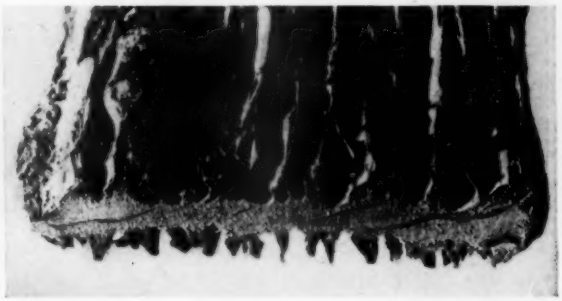
This attack may cause a reduction in size or it may produce a porous, corky surface. Several characteristics may be used to distinguish between chemical and biological attack in flooded portions of a tower, but examination of the fungi is needed to positively identify each type. The microorganisms usually penetrate the wood and do some damage throughout the piece. This reduces structural strength, causing the brittle condition known as brashness. Identify this condition by breaking a piece of wood and noting the fracture. Normal wood breaks with a series of fractures, accompanied by splitting along the grain. Splitting disappears with brashness and the failure becomes a single fracture squarely across the grain.

**Internal Biological Attack.** Deterioration within the wood occurs under the surface, often leaving a sound shell of wood, p 113. The degraded wood is normally light brown in color and crumbles to a brown powder when handled. In the early stages the wood is often delaminated, the laminae corresponding to the annual rings. Examination under a microscope shows that the summerwood was attacked first and was selectively degraded, leaving the springwood in integral laminates, p 113.

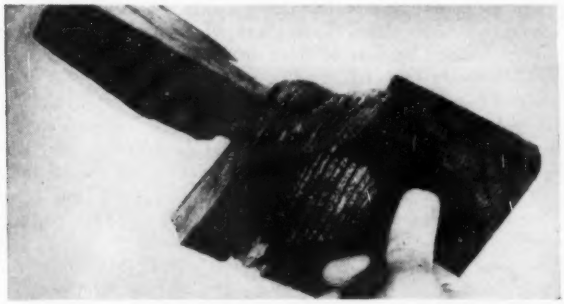
As pH or chlorine residuals increase there appears to be greater intensity in the attack. This is known to remove, or reduce, the natural toxic extractives in the wood. Unfavorable combinations of pH and chlorine are believed to react rapidly with extractives near the surface of the wood, lower their concentration near the surface. Extractive content within the piece of wood is gradually lowered. Eventually, conditions favorable to fungi growth develop.

This internal biological attack may be the end result of fungal action, with chemical action preceding it. In towers studied for this report deterioration of this type occurred with greatest intensity in the nonflooded portions of the tower on the leaving-air side of the water distribution system. This concludes a brief survey of our studies.

**9** Moderate intensity of surface biological deterioration. This type shows about a straight-line relation to age of the wood



**10** Surface biological deterioration of severe intensity, as found in one of cooling towers studied for the report summarized



**12** Thumb pressure may detect severe internal biological degradation if internal infection is in advanced stage

**13** Temperature effect on *rate* of deterioration: *L* to *r*: upper deck; central flooded deck; lower level; unused

algaecide concentration and deterioration. Increasing chlorine from 0 to 1 ppm at pH 6.0 raises surface and internal degradation only slightly. As chlorine concentration increases, deterioration rate decreases in a pH range of about 7.5. With pH at 9 and chlorine increasing between 0 and 1 ppm, deterioration rate goes way up.

**Maintenance.** Chemical attack of tower wood can be controlled to a large extent by water treatment. Keep pH at 7 to 7.5. Make periodic inspections of the wood, removing algae, mud and other deposits. Clean the entire cooling system while working on tower. Remove infected wood from tower as soon as it is found, Fig. 12.

OPERATORS' NOTEBOOK 72

# Let's Take Over Watch

**1—Read logbook carefully to see what happened on the previous watch . . .**

**YOU ARE RESPONSIBLE** for the plant the minute you take over a watch—your reputation as an operator is at stake. Study the logbook, and make sure you know of any unusual conditions that arose on the previous watch. A smart operator can often prevent breakdowns from telltale entries.

Above is a photo of George Green, first assistant engineer, studying the log in a smoothly running plant.

**Use selector switch** to check each cylinder's exhaust temperature. If temperature to any one cylinder is high, check log sheets to see if it has been high before. If not, adjust fuel oil to that cylinder until temperature is the same as in others.

If that cylinder knocks, it might be overloaded. If all its adjustments are right and it still knocks, the cause might be that the cylinder firing before the knocking cylinder is dead. Then this one knocks because it does the work of both. If dead, check fuel pump, also valve mechanism for that cylinder, starting with camshaft. Check lube-oil temperature going into engine. Adjust cooling water to lube-oil cooler if oil temperature isn't right.

**Next, check fuel,** lube and cooling-water pressures. Try to keep them as nearly ideal as possible. Lube-discharge temperature from engine often warns of overheated bearing or badly overheated parts inside. Try to locate cause by feel, or by listening carefully with ear to flashlight placed against various parts of engine housing.

Cooling water from engine tells the same story as lube oil from engine. If temperature has been climbing gradually over several weeks, the cause is usually scale building up inside engine jackets. Or it could be a fouled heat exchanger.

Make sure you know where lube oil is in governor by looking at oil-level sight. Keep level right. If it is a self-cleaning lube-oil strainer, give handle one turn as in photo. That scrapes strainer clean. Then check oil pressures to see if they have changed because of clean strainer.

**Crankcase oil** level should be up to mark. Check it with bayonet, and make sure you read it correctly. Lubrication is the engine's lifeblood. You can't always depend on the engine's tachometer readings. Good investment for your plant is a hand-type revolution indicator. Place it on end of shaft at pedestal bearing. If engine's critical speed is known to be within operating range, make sure engine runs slightly over or below this speed. While at the pedestal bearing, feel the bearing and, if it is oil-ring lubricated, look inside for good measure to see that rings are turning and level is right.

**Trouble** with modern engines is they run well with little attention for long periods. Then operators get lax, and they forget to make their rounds as they should.

While on watch, keep on your toes during peak-load periods. Get the habit of listening to each engine when taking over watch, and while making each round. Listen at each cylinder until you get so expert that you can detect any unusual noise. After a while you will know what every little sound means. Before turning watch over to your relief, be sure to tell him about anything that might give him trouble.

# In a Diesel Plant

By STEVE ELONKA, *Associate Editor*

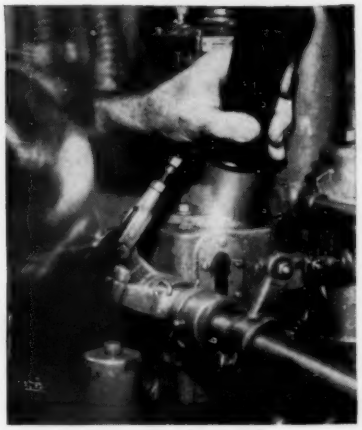
2—Check: Cylinder exhausts . . .

3—Lube-oil temperature . . .

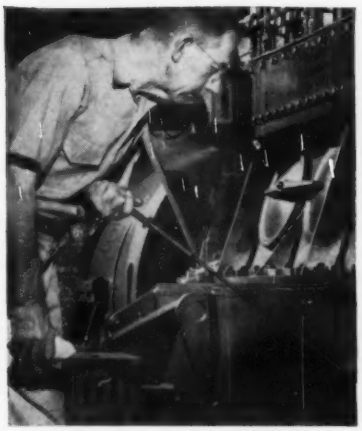
4—Fuel, lube, cooling pressure

5—Check: Lube discharge . . .

6—Cooling discharge temp . . .



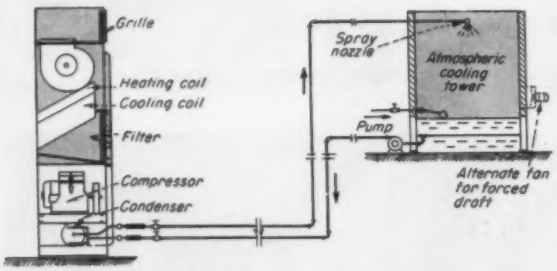
7—Governor's oil level



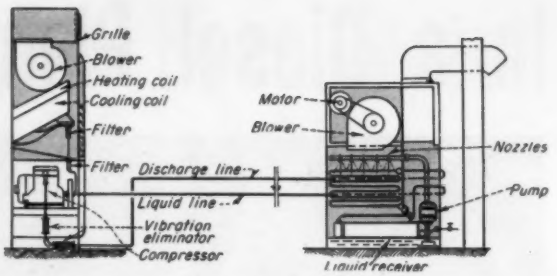
8—Check: Crankcase-oil level

9—Shaft revolutions

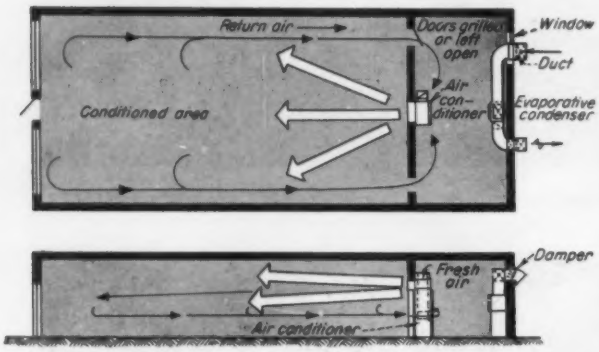
10—Clear: Lube-oil strainer



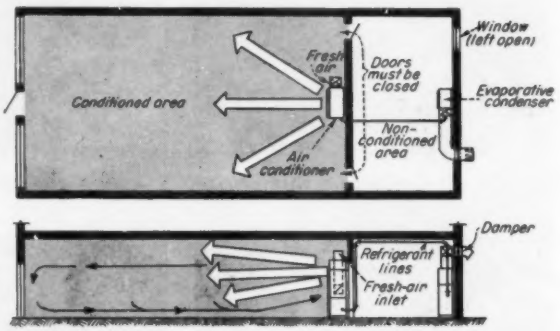

**1** Typical piping hookup for a self-contained conditioner uses an atmospheric or a mechanical-draft cooling tower




**2** Evaporative condenser hooked up to a self-contained air conditioner. Condenser location is extremely important

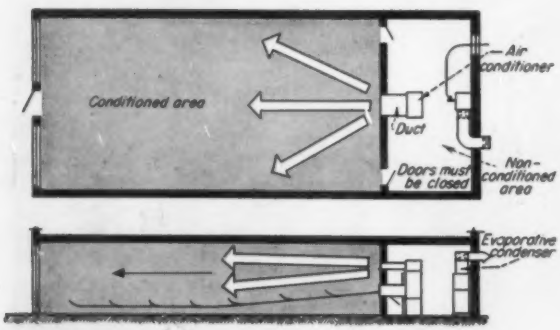



**3** When conditioner and evaporative condenser are in the conditioned area, condenser must have air inlet, outlet

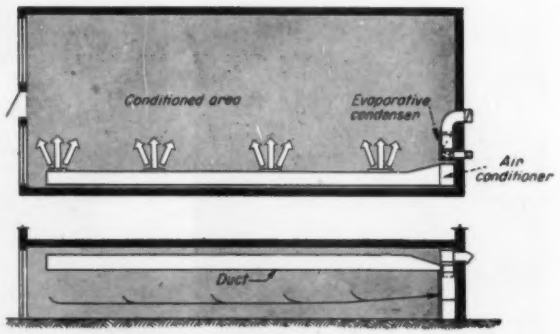



**4** When evaporative condenser is in a nonconditioned area, a window must be left open for intake. Fit exhaust duct

# Planned Installation, Now, Saves Air-Conditioner Headaches Later




**5** Use an open window or duct, as shown here, when the conditioner and condenser are in same nonconditioned room




**6** Another arrangement for conditioner and evaporative condenser when both are in the conditioned space. Note duct

***Self-contained units are better than ever but to insure the right output, scrutinize all installation details. Here are good checks***

By TYLER HICKS, *Associate Editor*

► THE SECRET of best service from self-contained air conditioners is correct installation. These tips will start you off on the right foot.

**Location.** When conditioner is in space served, you need run only electrical, water and drain lines to it. If it is outside the conditioned space, supply and return air ducts must be run between unit and room. Also, a fresh-air connection to the conditioner is usually recommended when unit is outside room.

Mount the unit on a strong floor. Check allowable floor loading to see that you do not exceed it. Use a base under the unit to distribute the weight over a greater area if allowable floor loading is low.

**Electrical.** Use manufacturer's data to size supply lines and fuses. Remember, undersized wires cause low voltage at unit, increase power consumption and may make overload devices trip out. So don't pinch pennies—you'll regret it sooner or later.

Be sure wiring conforms with local code. Where runs are long, step up wire size to reduce voltage drop.

**Water.** Undersized supply pipes from city-water mains cut water pressure, increasing power consumption of the unit and reducing refrigeration capacity. Most units using city water for condensing are now fitted with an automatic water-regulating valve. Pressure loss through valve is often a rather sizable item and should never be overlooked in system planning.

Figure pipe size so there's sufficient pressure available to overcome drop through water-regulating valve and the condenser. Manufacturer will supply data on loss through these two devices.

To find water pressure available at regulating-valve inlet, subtract from city-main pressure the loss through water meter, piping, elbows, fittings and valves. If main pressure is low and water temperature high, pipes will require special care in sizing.

Most self-contained units have a rubber hose installed on the outlet of the water-regulating valve. This isolates vibration of the unit from the piping. Make a solid connection between water valve and piping so, when valve shuts, the water pressure acts on the pipe, *not* the hose.

**Cooling Towers.** Where local regulations prohibit once-through use of city water for large self-contained air conditioners, either cooling towers or evaporative condensers may be substituted. Some conditioners have twice the number of condenser circuits for cooling-tower operation as for city water. So tell manufacturer beforehand what type of cooling system you intend to use. Then he'll reconnect condenser to suit.

The automatic water valve is not needed with a cooling tower, Fig. 1. Also, the rubber hose is replaced by a flexible metal hose to reduce the transmission of vibration from one unit to another.

Pump and piping for cooling tower, Fig. 1, must be correctly sized for the flow rate needed. Usual procedure is to figure a flow of about 3 gpm per ton for units on cooling towers, 1.5 gpm per ton for city water.

Adequately sized condensing-water piping saves in more than one way. Besides cutting power input to conditioner and insuring rated output, it also reduces power needed to drive the water pump.

**Evaporative condenser** can be used in place of a cooling tower. It performs a similar function of conserving water.

It is usually simpler to install the evaporative condenser, Fig. 2, in a room outside the conditioned area. Then the condenser's fan can discharge to the outdoors.

When evaporative condenser must be installed in the conditioned area, separate fresh-air and discharge ducts to the outdoors are necessary for air supply to and exhaust from the condenser. Be sure the condenser does not exhaust air from the conditioned area. Likewise, moisture-laden air discharged from condenser will overload conditioner, so this air should go directly outdoors.

Be sure connections to condenser are tight enough to prevent air leaks into or out of the ducts. Though leaks are not serious in mild weather, they may hamper conditioner operation during hot humid periods.

**Water Supply.** Makeup water for your tower or evaporative condenser should come from a dependable supply. Be sure water treatment, if required, is properly specified. Filters are also advisable because they remove solids that might clog spray nozzles.

**Layout.** Fig. 3-6 show several typical installations of conditioners and evaporative condensers. These illustrations point up the importance of good location on conditioner performance.

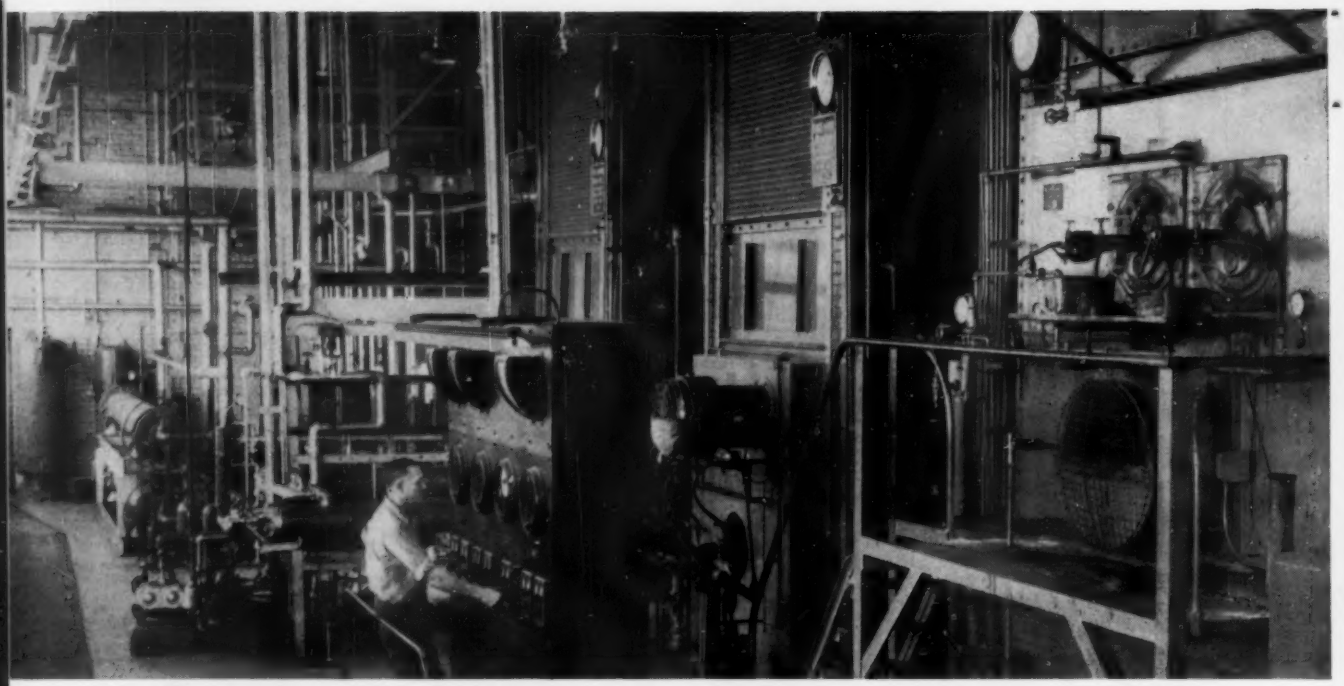
Never overlook the fact that air is a raw material just like water, coal, oil, etc. To use air you must have a supply from some source. For air-conditioning units, evaporative condensers and cooling towers the source is outdoor air. So always provide an inlet opening for air to be used in these units. Likewise, an exhaust opening to permit discharge to the outdoors is a necessity.

Keep intake and exhaust openings as far apart as possible. This prevents recirculation of air between inlet and outlet and a reduction in unit efficiency. To avoid complaints from passersby, locate discharge high enough to prevent impingement on any part of the human body. Have air intake high enough to prevent dust and dirt from entering with the air. Attention to details before installation will prevent troubles after the unit goes into service.

**Operation.** With Freon refrigerant, suction pressure in self-contained units usually ranges from 25 to 40 psi. Discharge pressure will run between 95 and 130 psi.

Low suction pressure and reduced capacity may result from dirty filters, not enough Freon, clogged strainer or expansion valve, or moisture in the system. Excessive suction pressure may be caused by worn valves in the compressor.

When discharge pressure gets too high, look for poor water flow to condenser, air in the system, fouled condenser tubes, overcharge or too small an evaporative condenser.



**Modern boiler room: Heart of high-temperature water system in which...**

# Pumps, Boilers, Piping Join Up to Cut

By **HARRY W RAMBO**, *Plant Engineer, Synthane Corporation*

► THERE'S NOTHING NEW about using hot water for space heating. But high-pressure hot water for process work is still uncommon in the U.S. One of the most interesting applications today is in manufacture and fabrication of thermosetting plastics. Synthane Corporation, at Oaks, Pa., provides an excellent example of efficient use of high-temperature water in this work.

**System Details.** Back in 1936, Synthane chose hot water to replace steam because it appeared more economical and promised to provide uniform heating for treating equipment, tube winders, ovens, laminating and molding presses. The installation is said to have been the first by an American firm.

Aside from the basic raw materials that go into laminated plastics, heat and pressure are two fundamental process requirements. Hydraulic pressures needed in processing are furnished by pumps and accumulator systems. But the heat may come from steam, hot water, electricity or gas.

There are two major process-heat requirements at Synthane —for the evaporation of solvents during the impregnating operation, and for heating the various types of presses where final processing takes place.

**Processes.** Resin-treating machines or coaters need high-temperature air for solvent removal and for partially curing resin-impregnated papers, textiles and other filler materials. Before being laminated into permanently polymerized sheets, tubes or rods, rolls of filler stock must be drawn through troughs or tanks of synthetic resin varnish.

After this, the filler passes between preset chilled iron rolls, which squeeze off the excess. Drying then takes place in a 60-ft horizontal-type dryer. After this the material is rerolled for further processing.

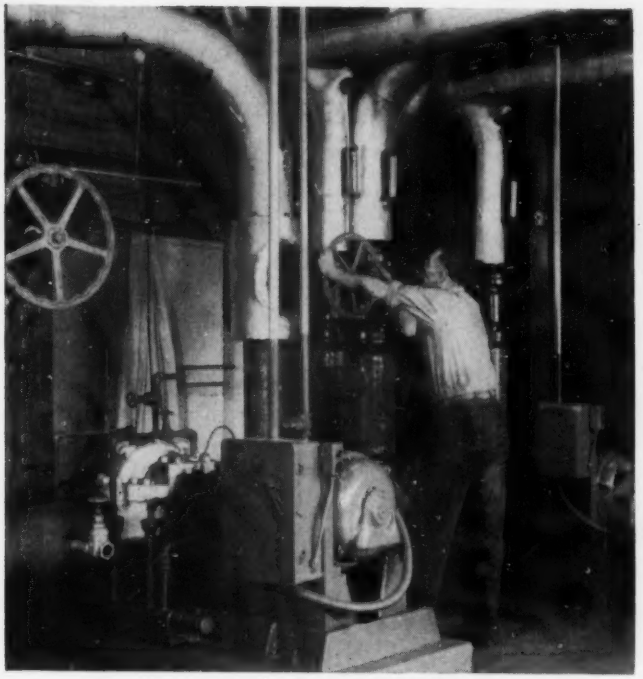
**Dryers** are an interesting application of high-temperature high-pressure hot water because they use indirect heat from coils mounted in the circulating air stream. Fans handle incoming air and also recirculate and exhaust evaporated solvents. About one-fourth of the air handled at full load is discharged to the atmosphere. Remaining air is recirculated at strategic points along the dryer.

Another advantage of high-temperature water is the elimination of a complex return system. Besides, supply and return lines can be smaller size because the heat-carrying capacity of water is much greater than steam.

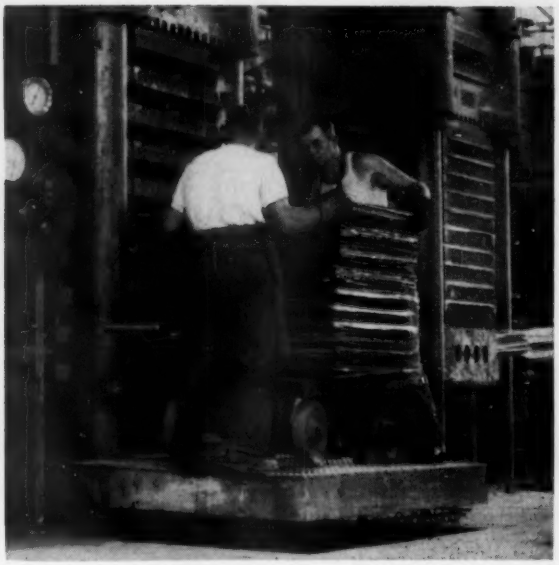
**Boilers.** An equivalent of about 18,000 lb per hr of steam is generated in three Edge Moor Iron Works boilers fired by Peabody-type oil burners with Bailey automatic control. Furnace is forced-draft, but 140-ft brick stack is natural-draft. Fuel is bunker C, delivered by tank trucks to three 15,000-gal storage tanks.

Two deep artesian wells supply raw water, makeup being softened before it is pumped to the boilers.

**Hot-Water Pumps.** Four Ingersoll-Rand refinery-type cen-



**Pumps circulate hot water to...**



**Platens of large presses and...**

# *Fuel Costs 20%*

trifugal pumps draw water from the boiler drums and discharge it to the distribution system. Pressure in system is 210-220 psi—the head needed to overcome friction losses in distribution piping, heat-transfer equipment and boiler-drum return lines. Return-water pressure is 185 psi, 10 psi higher than boiler operating pressure.

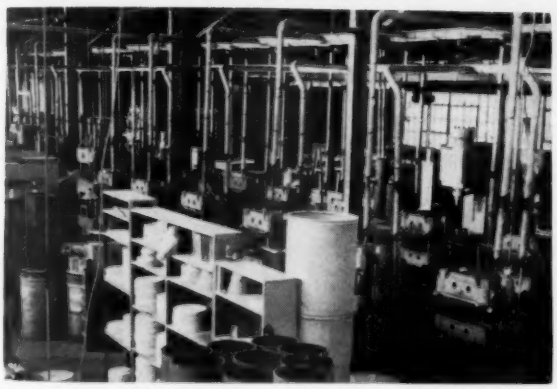
Suction lines go down to within 12 in. of drum bottom to avoid the danger of pumping the boiler dry. Water leaves the drum at 378 F, returning at about 330 F. Distribution headers run through the manufacturing areas. Welded taps are made at points where hot water is required for process.

**System Layout.** Piping parallels the production processes. Coating and drying machines are near boiler room. Throttling discharge of water from heating coils controls process temperatures. Experience in this plant shows that gate or cone-seated globe valves are best for this service.

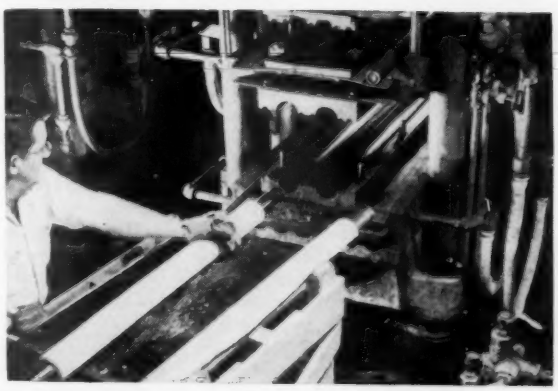
From coating and drying machines the materials move to the press room where high-temperature hot water is used in the jacketed platens. Heating cycle in press ranges from half an hour to five hours.

Tube-and-rod winding machines in the tube-and-rod department also receive hot water from the distribution system. Many small presses in this room mold gears, pulleys and similar parts. Small pumps draw hot water from distribution piping and circulate it through these presses. Volume pumped through press platen determines molding temperature. On tube rollers, temperature is controlled by throttling discharge.

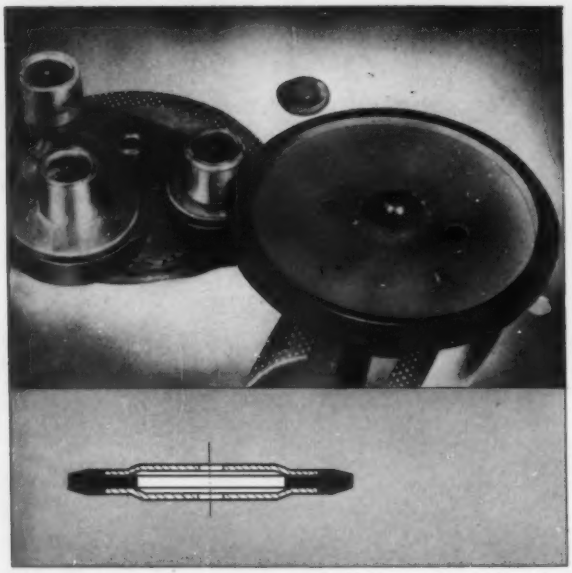
(*Continued on page* 212)



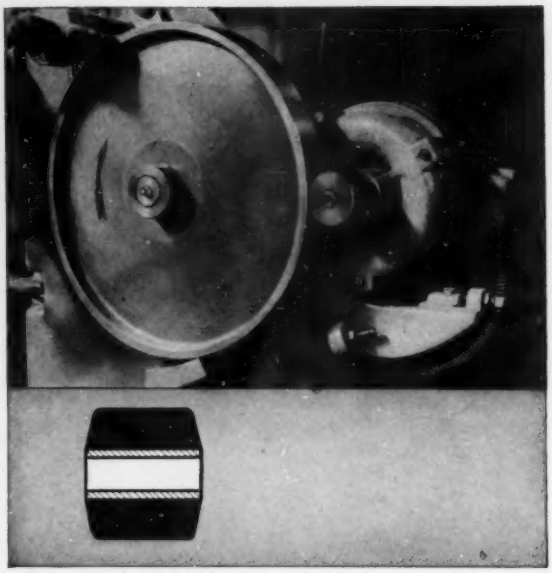
**Battery of small presses and to...**



**Tube-and-rod molding department**



**SMALL RINGS** mounted on disks or applied by tension drive phonograph turntables in the friction drives best-known today



**RUBBER CYLINDER** vulcanized on sleeve held on motor shaft is the popular way to drive medium-hp machines by friction

**SMALL** units, for applications like instruments, record players and other delicate apparatus, use rubber rings of small cross section. These are either held in place by disks, as above, or applied to the wheel by tension. In either case, rubber ring fits into a groove in the wheel.

Photo shows an automatic record player drive—an application requiring the noiseless and vibrationless operation that a friction unit can provide. Here the rubber ring mounts on the slow-speed shaft, and unit transmits only 0.05 hp. This use of friction drives is a very common and well-known application in the United States today.

**MEDIUM** drives, for average forces and power, use rubber cylinders vulcanized on a shaft or sleeve.

Application, *above*, represents a machine-tool drive. The rubber wheel is vulcanized to a bushing and held tightly on the stub end of a motor shaft. Unit transmits 1.5 hp; motor runs at 1400 rpm. Speed ratio is 1:6.9.

Pivoted and spring-supported motor base allows for automatic adjustment when the rubber wheel wears, as in the case of the large units, *p 125*. This feature practically eliminates the need for replacing the rubber wheel, once the unit has been installed.

# Today's Friction Drives Are Reaching

By H W HAMM, *York, Pa.*

► NEW ENGINEERING MATERIALS have made it possible to revive the friction-drive method of power transmission. A German manufacturer, Continental Gummi-Werke, has fitted friction pulleys on drives up to 100 hp, and believes the system can be used for transmissions up to 150 hp.

Chief advantage of a friction drive over a belt drive is the space saved. Sketch, *top right, p 125*, shows a 55-hp compressor drive. Substituting friction for a conventional belt transmission reduces space requirements by more than 50%. The 7-in.-wide friction wheel uses three rubber rings with standard-dimension steel-wire inserts. Speed ratio is 1:5.5 The original setup employed a 9-in.-wide belt, had a 1:5.3 ratio.

In addition, the new system cuts initial cost of the drive. It practically eliminates replacement cost, too, because the spring that keeps radial pressure constant compensates automatically for the slight wear in the rubber rings.

In the last century, this type of drive had frequent medium- and low-power applications. But when gear drives came into general use the friction drive was supplanted.

The old drives transmitted power through steel or cast-iron friction wheels fitted with mating grooves. Because of low friction coefficient for metal-to-metal contact, they required large physical dimensions and bearing loads, and this drive gradually became obsolete.

**Engineering** the new friction drives is relatively simple. Here are the limits for successful and economical operation, and data for determining the principal dimensions.

Circumferential velocity $v$ is limited to a maximum of 100 ft per sec. Usually it is about 15 to 25 ft per sec. This permits calculation of wheel diameters $D$ and $d$, sketch, *right, facing page.*

Tangential force $U$, in lb, for given power and speed requirements is

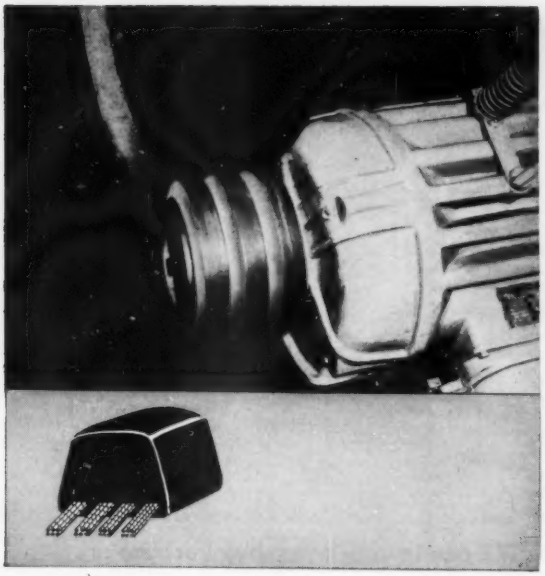
$$U = N(550)/v$$

where $N$ is power transmitted, hp.

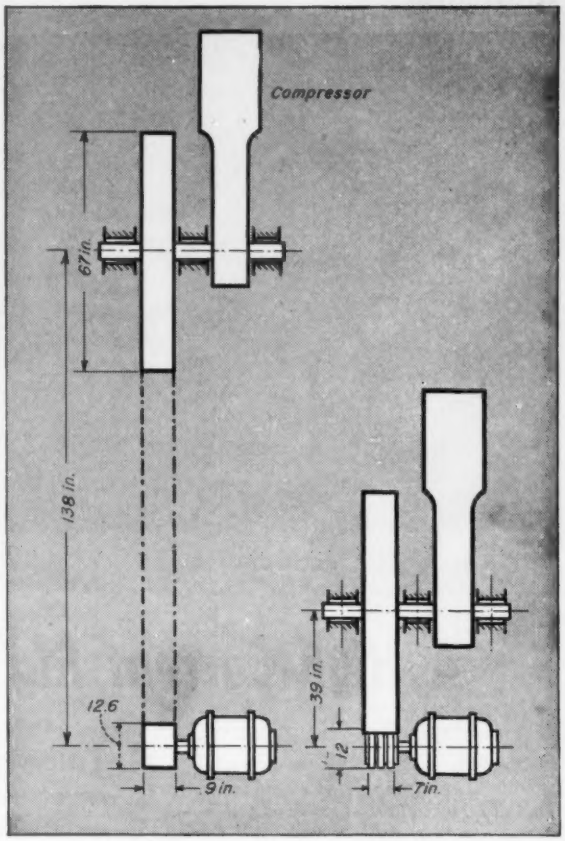
Tangential force determines radial force, since

$$U = f \times P$$

where $P$ is radial force, lb, and $f$ is the coefficient of friction. This coefficient is normally 0.8 for clean, dry wheels. But it varies between 0.5 and 0.9 Use the lower values where condensation in humid atmosphere or oily dust may produce a film on the wheel surfaces.



**RUBBER RINGS** with steel-wire inserts transmit up to 100 hp in the large-sized friction drives now coming into use




**SPACE SAVED** here exceeds 50%. Using friction rather than a belt drive also cut cost of this 55-hp compressor drive

# For 150 Hp

**LARGE** friction drives have already transmitted 100 hp, may be good for 150. Friction between two wheels, one rubber-surfaced, the other rough-machined metal, transfers the power from one rotating shaft to the other. Spring force or a weight maintains constant pressure, and motor base is generally pivoted to permit the slight automatic adjustments for wear.

For economy, the wheel running at the higher speed is usually rubber, which is specially suited for this service. In the patented application shown in illustration, *above*, three rubber rings with steel-wire inserts are pressed on the steel rim of high-speed wheel.

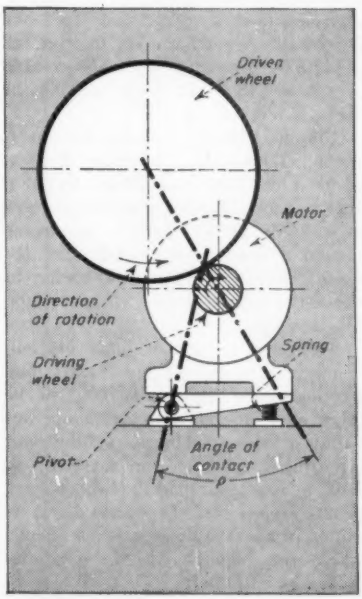
A friction drive can safely transmit a tangential force per unit of width, $U_s$, of 37 lb per in. You can determine the number of rubber rings and the width of each from this figure.

Allowable radial load per unit of width, $P_s$, is normally 46 lb per in.

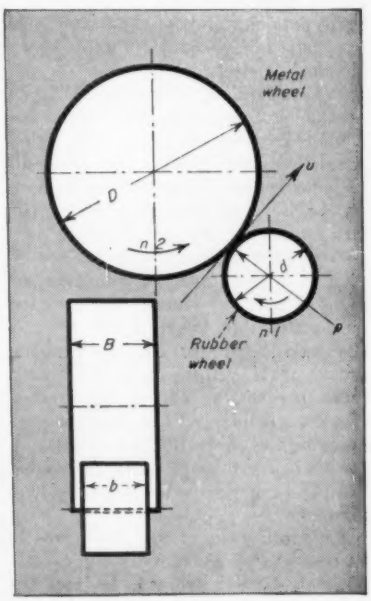
$$P_s = U_s / f$$

Width of the rubber wheel or ring must be smaller than that of the corresponding metal rim. Both surfaces must be flat, and width of the metal wheel rim $B$ must be greater than width of the rubber wheel rim $b$. See sketch, *right*. Difference is ¼ in. or more.

Although the theoretical angle of contact, *left sketch*, has been calculated as about 38½ degrees, operating tests show that you get the most satisfactory results when angle of contact is between 40 and 45 degrees.

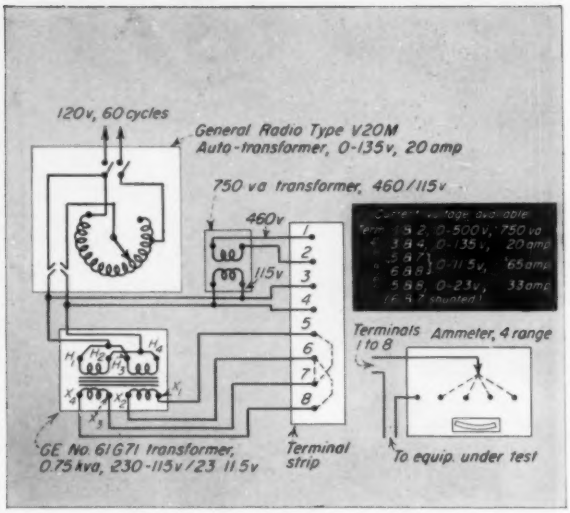



**MOTOR BASE** is spring-supported and pivoted to adjust automatically for wear




**RUBBER WHEEL** usually does the driving, must have narrower face than metal wheel

BUY a factory-designed unit, or . . .




MAKE one in your own shop because . . .

# A High-Current Rig Speeds Motor Tests

By P J BELCOURT, *Electrical Engineer, American Cyanamid Company*

► I FOUND that the key to successful trouble shooting hinges on a field-tested plan of attack, plus smart use of a high-current test rig. To be of true value the trouble-shooting plan must be simple and have a logical sequence that any plant electrician can follow.

**Most calls** boil down to finding out just why a motor overload relay kicks out or why a fuse or circuit breaker keeps popping. The trouble shooter must first determine whether the fault is mechanical or electrical.

Typical mechanical fault would be an operator attempting to overload the machine to increase production. If it's electrical, we often have to call upon our high-current test rig for the final answer. But before going into use of the test-rig, let's outline our plan of attack.

**Here's the Plan.** Say a motor is popping its heaters, and the lad answering the call pins the trouble down to the mechanical side. He then tells the mechanical department and his problem ends there. If overloading stems from too much product, he advises the production department, and once again his responsibilities cease. But if it's electrical, it's his baby—to track down the trouble fast, keeping production lost-time to a minimum.

Let's follow one of our electricians as he trots out on a motor trouble call. If thermals haven't tripped, he uses his voltage tester to check if the feed is live to line side of circuit breaker or fused switch. This is just ahead of the control equipment for the motor that's acting up. If one or all phases are dead, he looks farther back in the distribution system for the breaker of fuse that opened. Say he finds full voltage on all three phases on line side of the starting and control equipment; then, he looks for trouble from there on in. But for simplicity, let's say his only trouble signal on this call was opening of thermal relays.

**Thermal trips** are reset and the operator gets the go-ahead to restart his machine. Electrician then stands by for a spell to check whether machine operates as it should. He also runs his hand over the motor to see if she's overheating. He would use his split-core ammeter to check the current drawn while machine is operating.

Well, our electrician finds his ammeter reading normal and the machine perking along apparently OK, so he takes off to the maintenance shop. But within a few hours there's another call reporting trouble on the same motor. Back he trudges to find the heaters have again popped out. This time he must pin down the trouble source. And here's where the high-current rig generally makes its entrance

**High-Current Tester.** We've built this "portable" variable-current test rig that can be rolled to any point in the plant. The boys have christened it the "Casket" because of its shape. Sketch above shows the innards. Ammeter has four ranges: 5, 10, 15 and 50 amp. We also have the split-core ammeter for currents to 400 amp. Remember, some portable split-core instruments can measure voltage too.

With this rig and a megohmmeter, the electrician is all set to tie down the trouble. First, he opens the line switch and makes an insulation resistance check. With the megohmmeter alone he can spot whether there's a ground or break in a winding. But the variable current rig tells him if coil turns are shorted or if there's a short between coils themselves. It will also spot breaks in coil leads to the winding. Here's how he uses it.

First, he disconnects motor leads from the line starter and ties in lines from tester to any two leads going to motor. Current is adjusted to a value somewhat less than motor nameplate rating. The current is noted and switch to the test rig is opened. Then, without changing the current setting on test apparatus, he swings one of the leads from tester to remaining lead from motor.

Tester switch is again closed and current noted. If there are no turn-to-turn or coil-to-coil shorts, the second reading will be about equal to the first. Process is repeated on the third phase and current again noted. All three readings will be about the same if there are no internal shorts

But we go a step farther than merely

checking the current readings. While the test is being run on each phase we try to simulate operating conditions by slamming the motor with a 2x4 piece of lumber. This may appear crude, but it does to some degree duplicate vibration. If there are any hanging shorted turns, coils or make-and-break leads to a coil, they may show up in the current reading when motor is slammed. I've found the 2x4 test has saved us many hours in pinpointing motor faults.

**One case** comes to mind where our lumber test certainly proved its worth. It was a 13,500-rpm 60-hp motor operating at 240 cycles. Motor was water cooled in addition to having a hollow shaft for the product to pass through. Cost to dismantle and reassemble would be about $750. Several times in the past, similar motors were removed and replaced with a spare, and each time when brought to the shop nothing was found out of order. Weight of the assembly is about 550 lb.

On one such trouble call we used the 2x4 test, in conjunction with the high-current rig. We quickly found that one phase had shorted turns plus phase-coil shorts, but they would only show up when the motor was vibrated. Megohmmeter test showed windings clear to ground and from phase to phase.

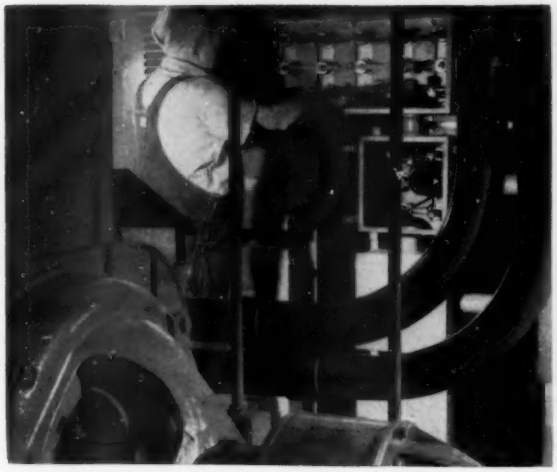
**High-current tester** also checks condition of overload relays. Without removing any leads from the motor or starter, electrician puts both leads from the Casket across the overload heater relay with motor switch open. Each heater is checked in turn. To spot a faulty relay—one that is tripping under normal motor currents—the tester is set to pass rated motor current through the heater. This value of current can be read right off the motor nameplate If heater stands up under this test, we then apply 200% rated current through the heater (not through the motor). It should kick out within 2 minutes.

We don't stop at motors and overload relays in applying the Casket. We also test circuit breakers and magnetic overload relays, using a similar technique. In each case we determine tripping characteristics in time and current.

Although we stressed usefulness of the high-current tester, do not overlook importance of the megohmmeter and the split-core ammeter. Remember the Casket won't tell you if insulation resistance has dropped below a safe minimum. That's a job for the megohmmeter. Our safe minimum is one megohm for equipment rated under 1000 v.

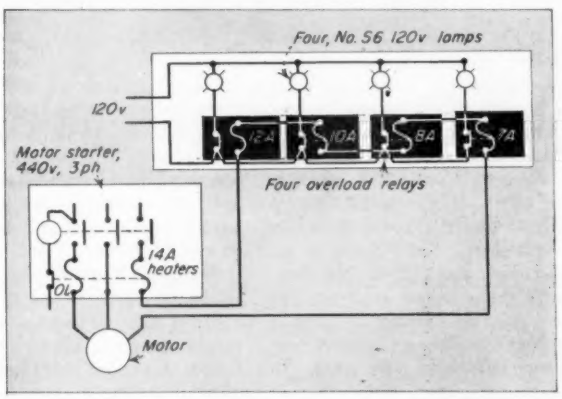
Likewise, the split-core ammeter tells you pronto whether (1) motor is drawing above rated current and (2) current through each phase is approximately the same with motor pulling load.

# Here Are Two Motor Operating Tips To Tuck Away for Future Use



**CAPACITORS** solved this motor-starting problem. A 400-hp 220-v synchronous motor was substituted for two 200-hp motors in the air-conditioning system of Kaufmann's Department Store, Pittsburgh, Pa. Heavy starting current drawn by the larger motor caused a 22% voltage drop, preventing motor from locking into synchronism.

Trouble was solved by installing a 135-kvar 3-ph 230-v capacitor bank near the motor. Starting voltage-drop was reduced to 13%, sidestepping a more expensive and time-consuming rewiring job—*Westinghouse Electric Corp*




**SWINGING LOADS** on a motor do pose a problem. Some swings may overload the motor for too long a spell, or if swings are for a short period, perhaps a smaller motor would do the job. To determine approximate hp a machine needs we use the above test hookup. Complete setup fits in a box and consists of four thermal overload relays and four pilot lamps.

Take a 10-hp 440-v 3-ph motor that should draw 14 amp at full load. Motor is on a machine that pulls anywhere from no load to high short-time overload: 5 amp to 50 amp. Short heavy-current swings don't mean motor is overloaded.

Connect tester in series with one motor lead in starter. Leave it there for a few days. Check back to see which pilot lamps are not burning. That will tip you off to the approximate hp machine requires.—*P J Belcourt, American Cyanamid Co*

**PRESSURE, VACUUM** work together cleaning m-g set without scattering dirt

**CANVAS SHROUD** has zippered openings for hoses

# Still Cleaning by 'Blow and Scatter'?

By F W KRAUS, *Supt, Methods & Tools Dept, Otis Elevator Co*

► IN MANY PLANTS, motor-generator sets are not cleaned as thoroughly or as often as needed, chiefly because of the method used. Uncontrolled "blowing" of m-g sets boils down to merely *rearranging the dirt*. Controllers, selectors and other electrical equipment wind up under a layer of dirt that can lead to a trouble call later. Since there is no annoying copper and carbon dust floating around there is less tendency for the man doing the cleaning to hurry.

**Our answer** to blow-and-scatter was to substitute a blow-vacuum setup. In brief, it consists of a cover that is draped over the equipment to be cleaned, a hand blower and a heavy-duty vacuum cleaner.

Cover is made from heavy cotton drill, coated inside and out with oil-resistant neoprene. It is fitted with 15 strategically located 2-way zippers. In our case the cover was developed to fit m-g sets of several sizes.

**Setting Up.** When the cover is placed on a set in the correct position, longitudinal center seam, which joins both sides to cover, is centered over set's eyebolts. Then the four crosswise zippers in the middle-center fall over the machine's vent openings that separate motor and generator. Sides of cover should touch floor all around. Where machine base is unusually high so cover sides fail to touch the floor, we tie cover bottom to machine base with twine. Zippers are kept closed at all times except to permit blowing and to hold suction bell on end of vacuum hose.

**Blowing.** When the equipment is all set up, as shown in photo above, open a zipper at some point so blower nozzle can be inserted. Then slip the vacuum hose with suction bell intake on its end through another zipper. Close this last zipper tightly around the hose to hold it in place. Vacuum line is always facing the same direction from which dust is being blown. Its position is changed as blower position and direction of dust movement are shifted.

When all make-ready is completed, turn vacuum unit on. Then insert blower through zipper and start blowing. Under the cover, vacuum power unit, drawing 210 cfm, sets up an air stream from point where the blower is inserted. Dust pushed loose by the blower is caught up in this air stream and drawn into vacuum tank through suction intake.

During cleaning procedure no dust escapes, so no clean-up is needed after the m-g set is finished other than wiping off surface dust or sucking up heavy dirt that may have fallen to the floor inside cover.

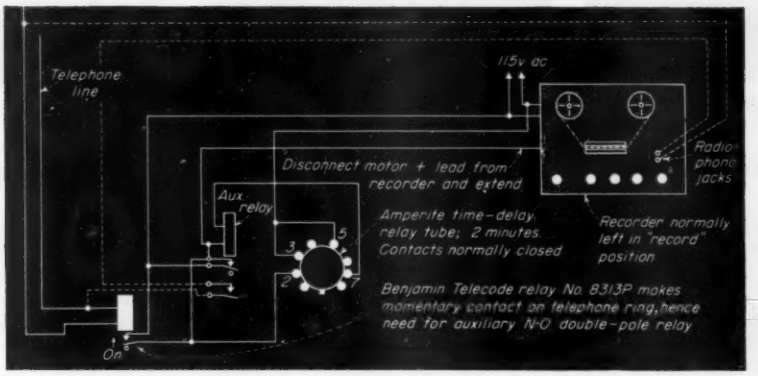
So a man doing the cleaning can direct maximum air into vent openings at both commutator and field sides, we made up a set of 90-deg elbows. These attach to 1½-in. OD adapters fitting the average blower hose. Nozzles fit directly into vent holes directing maximum air force into these parts. Incidentally, the area around commutator is the part that must be kept cleanest.

**Tips on Using.** We've found a 1-hp blower does the best job on our m-g sets. Dust on motor or generator innards will stay there unless a strong force of air is directed fairly close to it. Yet there are times when air pressure alone won't loosen the caked-on dirt. That's the time to use a stiff-bristled round brush. This is especially true around bearing housings and inside of ac rotors.

Where you meet up with m-g sets having exciters, drop the end bell for ease in blowing out the vent orifices. Always use a 90-deg attachment when directing blower's working end into vent orifices in commutator of motor or generator. Then the air will not blow oil from bearing reservoir.

**Modernization Awards**
**See page 100**

# This Modern Tape Recorder...


Telephone line
115v ac
Disconnect motor + lead from recorder and extend
Radio phone jacks
Aux. relay
Amperite time-delay relay tube; 2 minutes. Contacts normally closed
Recorder normally left in "record" position
Benjamin Telecode relay No. 8313P makes momentary contact on telephone ring, hence need for auxiliary N-O double-pole relay
On

# ...Replaces Phone-Boy for Log Readings

By L W FITZPATRICK, *Chief Engineer, Department of Correction, Jefferson City, Mo.*

► EACH PLANT—steam, diesel, power, ice, water pumping, filtration and sewage—makes an hourly telephone report on loadings to the Chief's office. Info is then tabulated into a running hourly log. That's more or less standard in all plants. Answering the phone was a constant source of interruption demanding that other work be stopped to take down the readings.

Now, with a tape recorder hooked into our plant telephone system, the hourly reports are automatically recorded. Later, one of the office secretaries makes the entries while playing the tape back through a set of earphones.

Each of the above plants report on a staggered 5-minute schedule: first starts on the hour, second follows five minutes later, etc.

Reports stop flowing when the Chief's office closes up for the night at 10 pm. But this doesn't prevent individual plants from funneling messages into the recorder during the night. When they do, the information is on the tape bright and early the next morning without error or possible loss.

A companion tape recorder helps out nicely by assisting during monthly inventories of maintenance supplies on hand. This is a real time and money saver, too, since the pencil work is done in the main engineering office with lower-cost stenographic help rather than with operating engineers. To check inventory, roving auditors take down the field data in the plant on a recorder at 1⅞ in. per sec. This is transmitted to the main office at 7½ in. per sec. Back in the office information is picked up at 7½ in. per sec and played back for transcribing at 1⅞ in. per sec. This speed-up for transmitting over the phone lines means many minutes of dictation can be packed into one minute, eliminating telephone tieups.

When the auditing force returns to the office later in the day, all their recorder-phone reports have been typed up and are ready for an OK.

Finally, since this is merely dictation over a private telephone system, there is no need to introduce the FCC "beep" signal every 15 sec.

If the added cost can be justified, a telemetering system will give excellent results also. But we find the simplicity and low cost of the tape recorder meet our needs. Similar units may also find other plant applications in the future. Conferences and training programs are typical candidates.

# *Latest* PRACTICAL IDEAS *to slash your skyrocketing*

**Scored piston and pin . . .**

**Scale inside the jacket . . .**

**Scale on the cylinder liner**

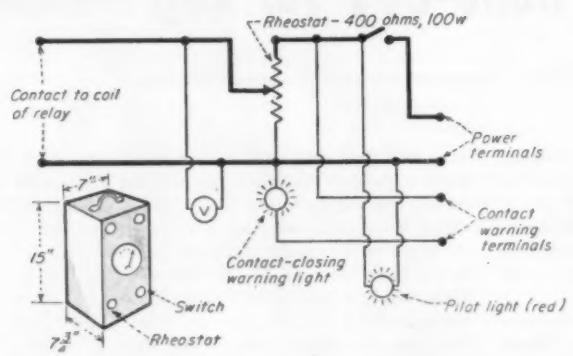
## Don't Let Pond Water Wreck Expensive Diesel Engines

BEING an erection superintendent for a large diesel maker, I always try to sell owners on installing an efficient cooling system for their new engines. But many owners think they are cutting costs by pumping water out of any pond to cool their diesels. Or the cooling water isn't treated with chemicals to avoid scale.

Photos show scored piston and liner of a new installation. After making an expensive trip to solve problem, I found liners outside badly scale-coated, photo.

This costly engine came inches from being completely wrecked. Sad part of this story is that repairs cost much more than original cooling installation I suggested. This kind of thing happens so often that we manufacturers accept it as part of the game. Of course, we wonder if owners will ever learn.

FRED CARTER *Buffalo, N. Y.*




## Relay Tester Checks Pick-Up, Drop-Out Voltages

SKETCH SHOWS a relay tester I designed and built. This setup is for testing diesel-locomotive control circuits. It can be used to test relays and contactors on higher voltages if you change range of voltmeter, pilot and warning lights.

It's excellent for checking pick-up and drop-out voltages. Also aids in adjusting same and it's reasonable to build. Parts can be obtained at any radio supply house. Use No. 14 conductors.

Operation is as follows: Connect one end of test leads to relay terminals, the other to a source of power that relay coil or contactor works on. This should be on hot side of switch, and circuit to coil must be open. Connect contact warning terminals (warning light) across the contacts of relay of contactor under test, with test leads. Connect, as in sketch, across the coil of relay or contactor with another set of test leads.

Move rheostat to maximum resistance; turn on switch; turn rheostat until relay or contactor closes, then light gives warning. At that point, note voltmeter reading to get pick-up voltage. Now back off rheostat until light goes out; note voltage which gives drop-out voltage.

To use for adjusting: If pick-up voltage is high, set rheostat to get correct voltage on meter. Adjust relay or contactor until the light comes on. If pick-up voltage is low, adjust relay or contactor and check with instrument until correct pick-up voltage is obtained.

K V SOUTHWORTH *Bemus Point, N. Y.*

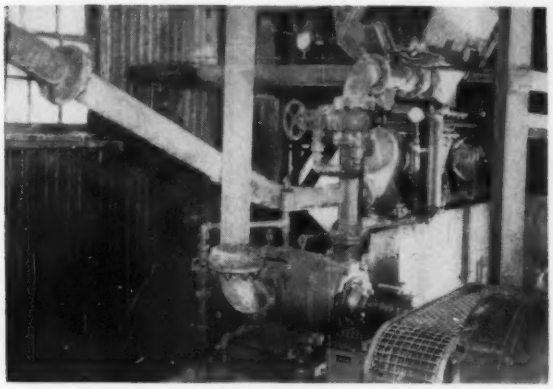
## Cleaning Burner Tips

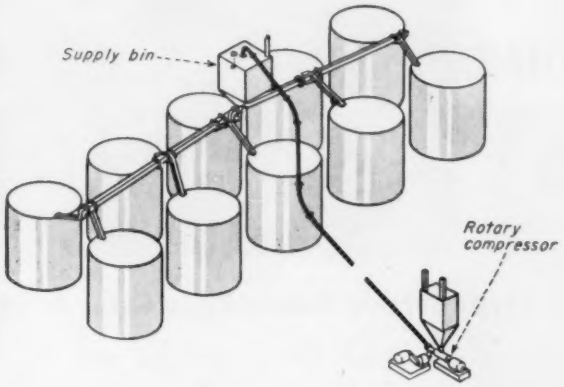
AN OLD TABLE KNIFE is handy for cleaning oil-burner tips because it's too soft to scratch tip. Cut blade to right size.

H HOLCOMBE *Los Alamos, N. M.*

# costs of operation and maintenance

STEVE ELONKA, *Associate Editor*





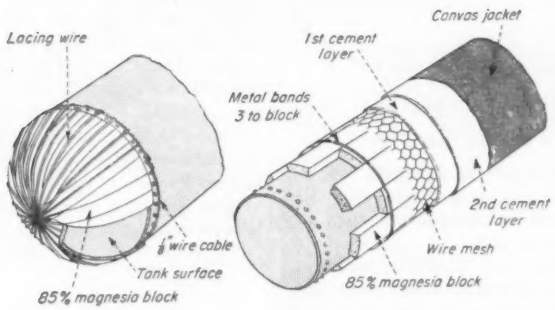

## Now, the Hot Dust Is Conveyed Pneumatically

WE RETURN DUST, recovered by precipitators in roasting of metallic sulfides, to furnaces for reprocessing. Dust temperature is 500 to 800 F and conveyor is a special pneumatic system. Roaster operation is more efficient when returning dust to the furnaces while they are hot.

Dust is gravity-fed from a hopper into pump shown, photo. Pump's screw element feeds dust into an air-mixing chamber in which it's made fluent by compressed air. From mixing chamber, compressed air at 15 psi delivers dust through a conveying line, sketch.

We find this an efficient way to move hot dust. It might offer a solution for problems that power engineers run into.

J FULLER *Catasauqua, Pa.*




## Insulation Stays on Hot-Water Tank

DON'T EXPECT insulation to stay on hot water-tanks if you don't put it on right. First, clean tank's surface to have insulation fit snugly. Stagger joints of magnesia blocks, sketch. If there are two layers of insulation, be sure to stagger joints of second layer with those of first. Hold blocks in place with ¾-in. metal bands, three bands to a block.

Apply magnesia blocks on tank's ends with adhesive cement. Then hold blocks in place with wire laced over blocks. Best way to anchor lacing-wire is to wrap a ⅛-in. wire cable around tank's end against rivets (sketch), piping or other projections.

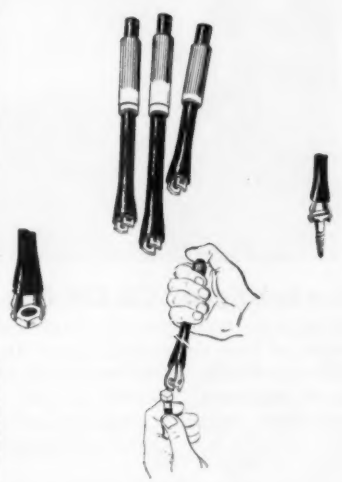
For indoor tanks not subject to moisture, wrap galvanized-wire netting tightly over blocks and wire in place. Apply asbestos cement in two layers, having total thickness of ½ in. For hard outside finish, add a little portland cement to second asbestos-cement coat. Paste 6- or 8-oz canvas jacket down over asbestos cement for a long-lasting job.

L GREIF *New York, N. Y.*

## Dissolve Tannin

TO DISSOLVE tannin easily, place in a wire screen basket and dip into a deep bucket of water. Stick steam hose into water and crack the valve.

H HOLCOMBE *Los Alamos, N. M.*



## Tip Wrenches Save Fingers

WE USE new hand tools to hold nuts, bolts and screws where fingers can't easily hold them. These wrenches tighten or loosen them in hard-to-get-at places. Tool is an adjustable socket pocket-wrench, as shown in the sketches. Each one is a combination self-adjusting socket wrench and screwdriver.

H T SMITH *Los Angeles, Calif.*

(*Continued on page* 132)

# More PRACTICAL IDEAS

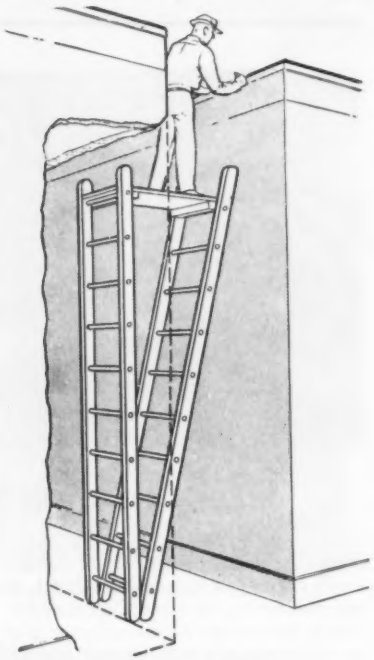
Begins on page 130

## Hypodermic Bench-Type Oiler Is Useful in Lab

WE USE a hypodermic lubricating-oil dispenser, photo, in our laboratory. Oiler is a polyethylene bottle (rubber-like squeeze type) with 1-in.-long hypodermic needle. It has a dustproof plastic cap to protect needle. Precision oiling of hard-to-reach holes is easy with the oiler. And oil inside it is visible at all times.

Because hypodermic needles have only 0.025-in. or 0.049-in. openings, exact amount of oil is dispensed. Because the drop is so tiny, there is no sloppy excess to be cleaned off equipment now.

R GAUNT *Chicago, Ill.*



## Two Ladders Make Safe Working Platform

WE DID MAINTENANCE WORK on walls of two buildings in narrow alley. Our longest ladder was too short to reach the roof edge. And alley was too narrow to place ladder at a safe angle. Sketch shows how we solved problem with two short ladders.

Platform was placed between sides of two ladders, and rested on rung of each ladder. For safety we nailed two pieces of wood to under side of board to keep ladders separated at the top.

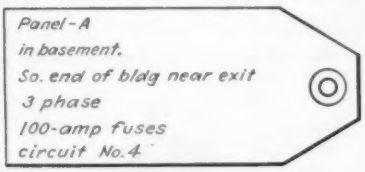
L KASPER *Philadelphia, Pa.*

## Bucket Keeps Oil Off Floor

EVEN THE BEST lube-oil pumps leak some oil from the packing gland. Our new electrically driven vertical pump is no exception. Because we have a very clean and shiny plant, we decided that a bucket looked better on the pump than oil smeared over it.

Photo shows hook, put on short drain-pipe section, to suspend bucket.

D L COCHRANE *Milica, Minn.*




## Tags Help Locate Power Panels Easily

WE MOVED our metal stamping and assembly shop to larger quarters. Our problem was to use fastest method for locating power panels of each machine. Also, to eliminate downtime and production loss each time a fuse burns out.

First, we tried marking the directory cards on each panel board. This meant going from one panel board to another until right machine was found listed. That was too slow.

Next, we tried large wall-directory cards, listing all machines on floor and on panel. This method required going to wall chart in center of building. We had to find machine on the long listing and walk back to panel board. That wasn't good either.

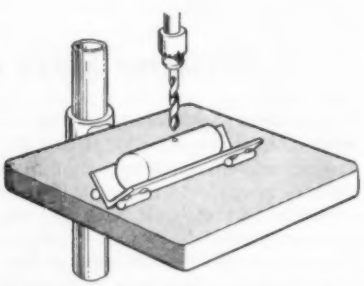
Then, we tried tagging each machine. Each tag now lists full information, sketch. Tags are best because now we don't have to "hunt and find." They save time: When a machine stops, first thing operator does is to go to it anyway. Now, the full information is right on the tag. And, what's important, no time is lost.

F LETTINO *Astoria, N. Y.*

## Watch Those Leads

WHEN YOU PUT your ohmmeter on the shelf, pull out the leads or turn the selector switch to OFF or some other position than OHMS. Then, if the leads accidentally become shorted, the battery will not be discharged.

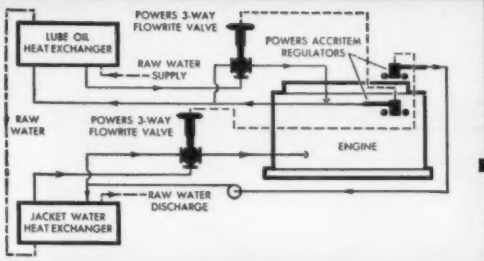
ED ECKERT *New York, N. Y.*



## Handy Fixture For Drill Press

HANDLING large, round work is easy. Make a large V-type fixture of angle iron and short pieces of round steel barstock, welded as shown. Ours handles round work on drill press.

W B LANGEVIN *Concord, N. H.*



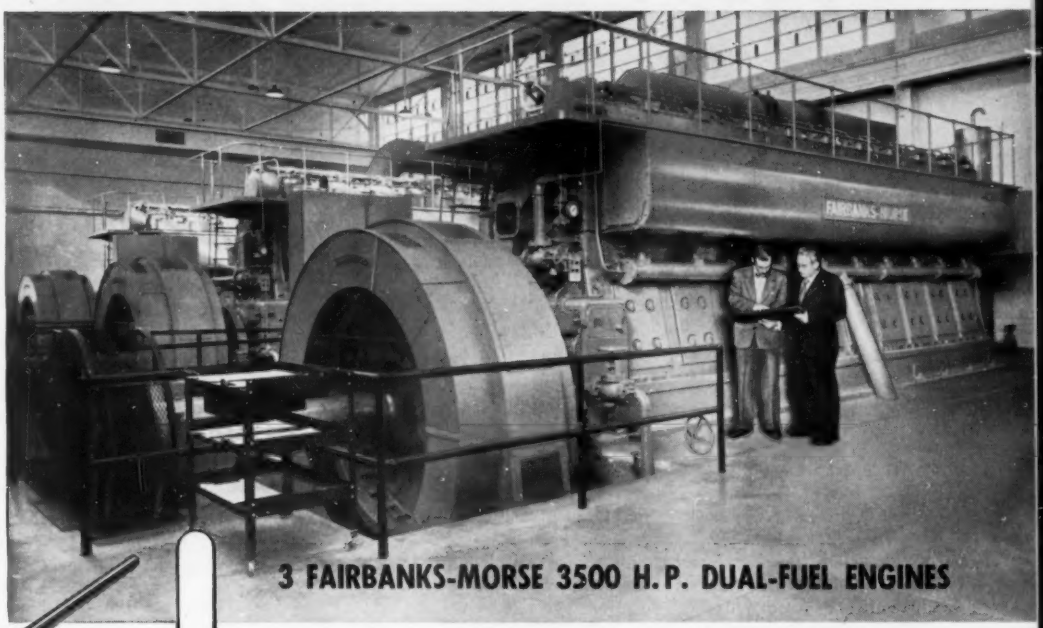

# *Right for the Job!*

**in the Hershey, Michigan Plant of**

## THE WOLVERINE ELECTRIC COOPERATIVE

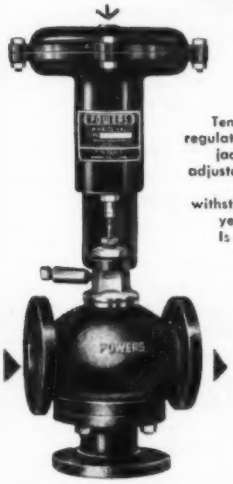
**Most Efficient REA Plant**

Winner of Award for most economically operated REA station in 1952. Six engines helped earn this distinction: 3 Fairbanks-Morse 3500 hp. Dual-Fuel Engines and 3 Cooper-Bessemer Dual Fuel engines.
**Consulting Engineers:** J. & G. Daverman Co., Grand Rapids, Mich.



**3 FAIRBANKS-MORSE 3500 H.P. DUAL-FUEL ENGINES**

**POWERS ACCRITEM REGULATOR** below is compressed air or water operated



Six of these Regulators and six **FLOWRITE** valves control lube oil and jacket water used in the F-M engines above.

Temperature sensitive bulb of regulator is inserted in lube oil or jacket water line. Has easily adjusted temperature adjustment dial. Rugged construction withstands vibration and insures years of dependable service. Is unsurpassed for reliability and power to control diaphragm valves.

Left: POWERS 3-Way **FLOWRITE** Control Valve. Six 6" pipe size valves are used in the above installation. They have many superior features which make them especially suited for large engines.

# POWERS Safeguards Engine Investment

## *with RIGHT Type of Temperature Control* for LUBE OIL and JACKET WATER

For each engine or air compressor there is a "best temperature for the lube oil and cooling water". To insure that temperature at all times regardless of variations in load or seasonal changes in temperature of water supply, install Powers Thermostatic Regulators.

**Powers Regulators have been time tested and proven reliable** on many large and small installations. ACCRITEM Regulators and FLOWRITE Valves shown at left are unsurpassed for dependable control of large size valves. For smaller engines Powers No. 11 Self-Operating Regulators have been widely used for many years. Either of these controls can be applied to your present engines if they are not already protected.

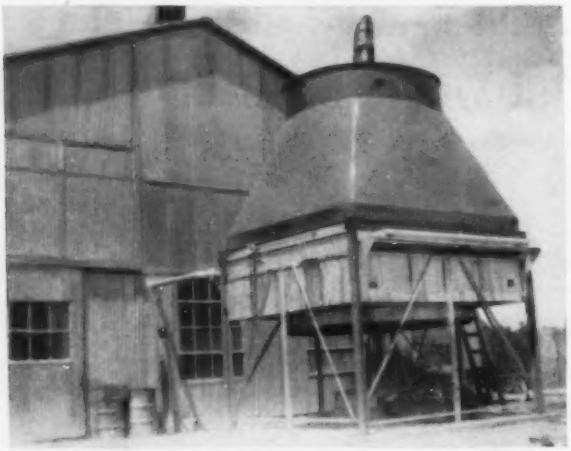
**For the Right type Control for Your Engines or Air Compressors—** contact Powers nearest office or write us direct. (b53)

POWERS CONTROL

## THE POWERS REGULATOR COMPANY

# More PRACTICAL IDEAS

Begins on page 130



## Stack Stops Heat Recirculation

ONE OF THE COMMONEST TROUBLES with radiators for cooling large diesel installations is recirculation. Photo shows such a radiator used for cooling several diesels. Almost from the start, this job gave trouble, especially on windy days.

With wind blowing from the west, partial vacuum was caused above the radiator, because of building's location. Hot exhaust air was drawn back by radiator's large fan and sent through coils, thus cutting down cooling effect.

We solved the problem by building a short steel stack above radiator so fan could force hot air far enough away to prevent recirculation. Plants with cooling troubles might check this angle.

FRED CARTER *Buffalo, N. Y.*

## Floodlights Protect Our Plant at Night

WE MADE exterior plant lighting sets, photo. Light stands are made of ½-in. pipes, driven two feet into the ground. Pipe cap on top is drilled and tapped for ¼-in. threads to hold lighting fixture or T fixture as shown.

T is formed of strap iron. Wiring is No. 12 neoprene-covered trench-wire, run to lights in a 6-in.-deep trench.

Lights are controlled by two switches inside our plant. Wire is taped to pipe after it leaves ground. Stand is painted.

D L COCHRANE *Milaca, Minn.*

## Bag in Reverse?

LOOKING INTO rear handhole opening of hrt boiler, I saw a bag, but this one was poking in, instead of out. Sure enough, there was a big dent on outside of shell, right at the bottom.

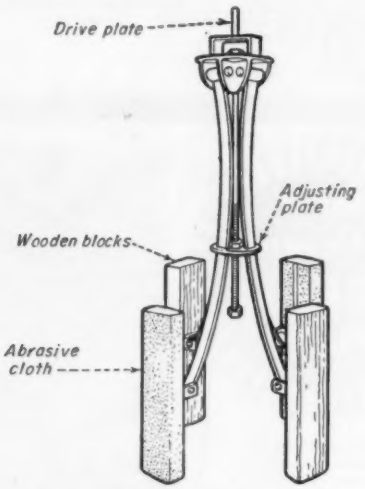
Fireman told me he had tried to jack shell up, because it had sagged. But instead of jacking against wooden cradle that fit shell at bottom, he jacked against the steel shell—and the shell gave.

I found the blowoff line bent, showing that the heavy shell had settled. So I inspected the brickwork and cast-iron columns the shell rested on. They were defective as a result of years of service.

I had them renewed after jacking up the boiler shell. Only this was done with two jacks, one placed under each end of a timber that fitted the curved shell.

Of course, all piping connections were broken before jacking, then made up after the job was finished. And a level told us when the shell was right. There are so many faulty boiler settings that it's a miracle more boiler accidents don't take place.

A CARTMAN *Albuquerque, N. M.*




## Auto Springs Make Handy Cylinder Hone

CYLINDER HONE in sketch was made from old automobile springs and scrap metal. Hone is used mainly for breaking glaze from cylinder walls before installing new piston rings. Then new rings wear in properly.

We fastened four automobile springs to a driving plate and to four wooden blocks, as shown. An adjusting plate is slotted to slide up or down on the four spring leaves. A ¾-in. bolt, threaded 16 in. from bottom, screws the plate up or down to adjust blocks to a minimum bore of 10½ in. and a maximum bore of 25 in.

Usually only two of the wooden blocks are fitted with aluminum-oxide abrasive cloth. The other two blocks act as guides. Hone is driven by a ¾-in. air drill. Cost for materials was about $8, and 15 man-hours were needed to build.

A E HAMALAINEN *Baton Rouge, La.*

## Easy Test for Hydrogen-Zeolite Softeners

HYDROGEN-ZEOLITE SOFTENERS lose softening capacity rapidly when nearing bed exhaustion. A simple electrical conductivity check will show gradual reduction of capacity. Microhms reading at start of service will decline to about a third as sodium ions break through. This is caused by hydrogen zeolite reacting with sodium carbonate to form sodium zeolite.

Conventional hardness tests at the start will be about identical when again taken at the same time as the above lowered microhms reading.

L W FITZPATRICK *Jefferson City, Mo.*

*they never get tired!*



• YARWAY Single-end Welding-type Gun-Pakt joint for 150 lbs. pressure.

• Some of the 189 YARWAY Gun-Pakt expansion joints installed at large oil refinery in Texas.

# *No fatigue* with 189 YARWAY GUN-PAKT EXPANSION JOINTS at this large Texas refinery

THEY just work and work for years and never get tired. Yarway Gun-Pakt slip-type joints simply will not fail through fatigue. They will operate smoothly, as frequently as required, over long, full traverse up to 12″ single type or 24″ double type or short, partial traverse, day in and day out—with never any danger of metal fatigue or failure.

This is just one of the many big advantages found in Yarway Gun-Pakt expansion joints. Other outstanding Gun-Pakt features are:

1. Can be serviced under *full* steam pressure day and night, thus avoiding costly and inconvenient shutdowns.
2. Fixed Gun-Pakt gland serves as "built in" external guide and permits less costly and rigid pipe guidance than required by many other types of joints.
3. Lower pressure load on end anchors because excessive strains are eliminated.

Used for many years with success in well-known refineries, industrial plants, utilities and institutions. When replacing present joints or planning new steam lines, it will pay you to look into the advantages of the Yarway Gun-Pakt expansion joint. Write for Yarway Bulletin EJ-1913.

**YARNALL-WARING COMPANY**
100 Mermaid Avenue, Phila. 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

**YARWAY** — *gun-pakt expansion joints*

# PLANT PROBLEMS... *many readers give advice*

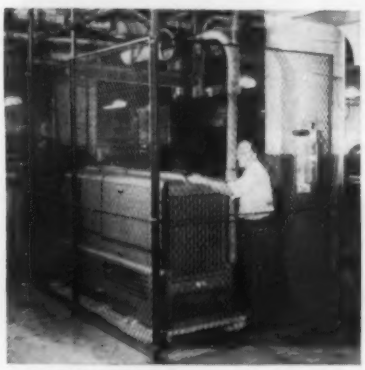
## What's Best Unit for Emergency Power?

**HERE ARE THE FACTS: Our large industrial plant produces typewriters. We buy our electricity, but a recent power failure caused much trouble in production areas of the plant. Though this is the only one we've had so far, we'd like to be ready for the next one, if it comes.**

**We figure a 100-kw gasoline, diesel or steam-turbine unit would solve our problem. Areas and units needing juice are: lights (exits, aisles, etc), sprinkler-supply air, elevator, hospital, stokers, floodlights, fire alarm, auto-call system, cafeteria refrigeration units and fans.**

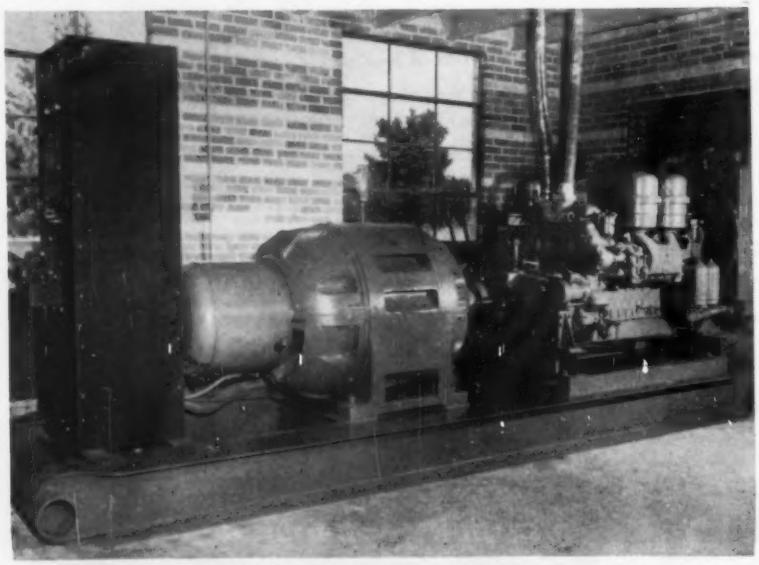
**Which drive is best? How should we connect emergency unit into system? Are there any other uses for emergency sets? What is the best type of control for our installation?—*PT, Nov Power***

## Here Are the Answers



**KELLAND'S** emergency diesel generator

**AIRPORT** has its set in small building



**MUNICIPAL EMERGENCY SET** is carefully installed for dependable output

**A CONSULTING ENGINEER** designed our system. As photo shows, it is well protected by a wire screen. Conduit leads from emergency set to plant feeders. The consultant figured load and capacity well. The unit performs fine, and setup is OK. See photo, *top left.*

DON KELLAND *New York, N. Y.*

**FIRE HAZARD** of stored gasoline makes this type of unit objectionable. A diesel seems best for *PT's* plant. Manual starting would reduce first cost of the unit. Emergency battery-operated lanterns that plug into normal lighting outlets are useful in critical areas. System can be wired so a relay closes the battery circuit when power fails.

A F JONES *Miami, Fla.*

**STEAM TURBINE** probably won't fit too well in *PT's* plant because it will need superheated steam for best economy and some provision for use of exhaust. Other problems include keeping an automatic steam valve tightly shut at all times, keeping casing drained, providing cooling water for lube oil, and the need for keeping steam pressure up at all times while there might be a demand for emergency power.

A diesel prime mover eliminates most of these problems, but it introduces higher first cost. Also, a starting system is needed, and *PT* may run into plugging of injectors while unit is shut down.

A gasoline engine seems the best for this job. First cost is reasonable, starts are dependable and efficiency is not too low. Use a storage battery for starting. Service the battery during the regular weekly test run of the emergency set.

Simplest installation uses a manual double-pole double-throw transfer switch to connect emergency set to plant bus. Sketch, *facing page, right,* shows typical hookup. Or two interlocked circuit breakers may be used. Another method has automatic bus transfer switch.

HOWARD HOLCOMBE *Los Alamos, N. M.*

**GASOLINE ENGINES** have advantages, for us at least, over diesels. They start quicker and require less maintenance. We like the cleaner fuel, ease of obtaining repair parts and the simple installation that goes with a gasoline engine.

We arrange engine so it starts automatically when main power supply fails. Emergency set automatically switches to bus after it reaches the correct speed

# on emergency power and stack carbon

TYLER HICKS *Associate Editor*

and voltage. When regular service resumes, a transfer relay drops the emergency power and the unit is automatically shut down.

*PT* should design his plant with emergency transfer switches for essential lighting. Manually transfer power to motor feeder and lighting panels. Instantaneous transfer can overload emergency generator. Be sure to include adequate short-circuit protection to prevent damage to emergency unit if it starts during a short in utility lines.

Size emergency unit liberally because plant loads will continue to grow in future years. Extra capacity is handy during damage to plant by fire or other conditions. You can drive power tools with the emergency unit.

Run standby engine and generator at least twice a week, keeping it on the line for at least an hour each time. Use a stop watch to check control action. It's wise to buy automatic controls as a package with the unit. Plant-built units are usually inefficient and most of the poor experiences with standby power have come from a lack of capacity and wrong maintenance.

Standby units are a convenient power source to beat demand charges for peak loads. If skidded, they are handy for remote power applications.

L W FITZPATRICK
*Jefferson City, Mo.*

**LIMITING ENGINE USE** to standby service puts the gasoline engine way ahead of diesels and steam turbines. Lower efficiency doesn't count because the running periods are seldom long. Also, gasoline engines require less technical know-how for good operation and maintenance.

If *PT* uses a gasoline engine he should keep its starting battery fully charged.

A J BREUGELMANS *New York, N. Y.*

**DIESEL FUEL** is less hazardous to store than gasoline, and there are no evaporation losses. *PT* can use a 150-hp engine driving a 100-kw generator at 1800 rpm. A unit of this size and speed can be electrically started by 24-v batteries. Cost of a gasoline engine might be somewhat lower than a diesel, and its fuel is easily obtainable.

A good layout and proper hookup permit switching load from utility to emergency unit with hardly any interruption in service. Automatic starting and switching equipment is available from a number of manufacturers.

Give careful consideration to connection changes at the load center when emergency load is picked up. Provide a positive disconnect with a double-throw switch with electrically-operated interlocks so the emergency unit can never connect to utility line.

*PT* should not overlook conferring with his utility. All public power companies are most willing to lend assistance in planning a standby installation.

Remember, the emergency unit can be used for fire-pump service. Insurance companies will allow you a credit for this type of installation.

FRANK BUTLER *Dallas, Texas*

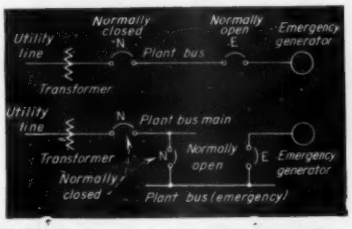
**NATURAL GAS** might be used in engine driving the emergency generator. A steam turbine appears out of the question unless *PT* now has steam he's discharging to atmosphere. Either a gasoline or diesel engine would probably be suitable, depending on conditions in his plant.

Tie-in of emergency unit may be made in any one of three ways: (1) manual (2) semi-automatic (3) fully automatic. Costs increase as controls are added to the unit.

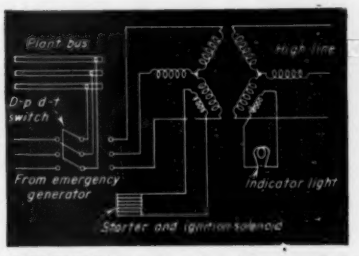
Before selecting and buying a unit *PT* should install recording instruments to determine actual demand of the various services that have to be operated when a power failure occurs.

CARL BUCHANAN *Rego Park, N. Y.*

(*Continued on page* 138)




**SAVAGE** says use either hookup, above




**HOLCOMBE'S** hookup has indicator light

**SKETCHES SHOW** two ways of connecting an emergency generator to plant bus. Top sketch is for a plant with a single bus fed by one utility line. Circuit breakers *N* and *E* are interlocked so either can be closed only if the other is open. This prevents emergency set from being paralleled with the utility line.

If *PT* wants the smallest possible emergency set, he can use hookup in lower sketch. Breakers *E* and $N_1$ are interlocked to prevent the emergency set being paralleled with utility line.

Consider six features seriously:

1. Interlock emergency generator circuit breaker and utility breaker to prevent paralleling at any time. Interlock may be electrical, mechanical, or a combination of both. Key-type interlock is desirable because it prevents operator closing breaker manually.

2. Provide automatic starting of the emergency set on low bus voltage, with a time delay to prevent starting on momentary voltage dips. Automatic closing of emergency circuit breaker after utility breaker trips is also desirable.

3. If rotating equipment forms a large part of the load that the emergency set picks up, provide an intentional time delay between opening of utility breaker and closing of emergency breaker. This cuts the possibility of large currents being caused by out-of-phase voltages of the emergency generator and plant motors. Remember, plant motors tend to momentarily act as generators when utility power fails.

4. Be sure to include the load to be picked up within a given time when writing the specifications for the emergency set. For example, 100 kw within ten seconds from a cold start might be specified for a diesel set.

5. Provide relays to prevent emergency breaker from closing when utility breaker trips after a bus or feeder fault that the feeder breaker does not clear. This avoids the possibility (perhaps remote) of the emergency set being connected to a high current fault that its circuit breaker cannot possibly clear.

6. Provide a test pushbutton for checking the complete system, either by simulating low voltage on the bus voltage relay or dropping out utility breaker.

NORTON SAVAGE
*St. Clair Shores, Mich.*

Turn to page 140 for your two new questions

# More PLANT PROBLEMS

Begins on page 136

**2-CYCLE DIESEL** is better for *PT* than other prime movers. Don't overlook the possibility of future increases in electrical load. If today's emergency load is close to 100 kw, consider installing a 125- or 150-kw set. Use breakers to divide emergency load into a number of different circuits. Wire them to a timing device that will close them in their order of priority and at long enough intervals to allow engine and automatic voltage regulator to adjust to the load.

If possible, he should keep cooling water and lube oil warm to permit a faster start. Either steam or hot water can be used for heating in a heat exchanger. Heating water and oil also prolongs engine life.

No matter what type prime mover is used, provide arrangements to produce artificial outages to test the set.

DONALD COCHRANE *Milaca, Minn.*

**CONSULTING ADVICE** is needed on this problem. Have a reputable consultant survey the plant to determine emergency power needs. See that enough space is available for installing the unit. If *PT* plans to use power from his emergency set at any time other than during a power failure, he should check with his utility. They may change his rate.

RICHARD CONK *Newark, N. J.*

**FIRST STEP** *PT* should take is to discuss his emergency power problem with the local board of underwriters and public-building and safety authorities. Installing a correctly engineered standby unit may permit substantial reduction in insurance bills.

To be truly an emergency generating set, his unit should be free of outside connections except for its outgoing bus. If possible, locate it in a reinforced-concrete building separate from the main plant. Provide heat for the emergency generating building to keep the unit warm at all times.

If a gasoline or diesel engine is used for generator drive, and jacket water is cooled in a radiator, fit shutters so warm air discharged by engine can be used to heat the room. Discharge this air to the outdoors in summer. Put shutters under thermostatic control, if possible.

HOWARD LIVINGSTON *Los Angeles, Calif.*

**ESTIMATE FREQUENCY** and cost of power failures before deciding how much to invest for an emergency unit. Simplest and cheapest standby installation uses an automotive-type gasoline engine directly connected to an alternator. Such units are not recommended for long-service heavy-duty applications, but they are satisfactory for standby jobs. Unit cost of fuel will be high, but not enough will be used to justify the extra cost of a diesel.

*PT's* plans for standby power require much additional wiring. He might find that generating-unit cost is a small part of the total job cost. Be sure to have an experienced engineer plan the job. It might be worthwhile to have an insurance firm study the situation and quote on rates for covering all losses resulting from a power failure.

IRA BUTCHER *Cincinnati, Ohio*

Other readers, sending good answers for which we lacked space, are:

A A HUNNEWINKEL *Woodstock, Ill.*
E A ROBERTS *Carlsbad, N. M.*
C G HOWARTER *Canton, Ill.*
H B WAYNE *Brooklyn, N. Y.*

## What Causes Stack Carbon in Our Plant?

**HERE ARE THE FACTS: We burn No. 6 oil under our two hrt boilers serving a varnish and insulator factory. Boilers, whose condition is excellent, are regularly inspected.**

**We get many complaints from neighbors in the area, however, about carbon flakes from our stack settling on their buildings and equipment. Our local smoke inspector has called several times and threatens to report us.**

**We've checked the boilers thoroughly, including draft, $CO_2$ and stack temperature. All readings are OK, pointing to good combustion.**

**What causes this carbon to form? How can we reduce it? Is it possible to eliminate it entirely?—*HW, Nov Power***

## Here Are the Answers

**INCOMPLETE COMBUSTION** during boiler load changes may cause *HW's* trouble. If response to air demand during load changes is slow, the air-fuel ratio may become undesirable, leading to carbon formation. The effect is lower combustion efficiency. There is no positive cure for this condition but he should carefully check all his controls to see they are in good enough condition to give the fastest response possible.

If droplets of fuel oil pass through the furnace without being ignited they settle on cooler surfaces and dry out. In time they flake off and pass out the stack. Cure by making sure all oil burns in the furnace. Check fuel-oil strainer and burner tips for cleanliness. See that oil pressure is right for burner tip being used. See that flame starts close to burner tip

R N OLSEN *Brooklyn, N. Y.*

**BURNERS CAUSE TROUBLE** *HW* reports. Check refractory around burner. It may be poorly installed or need repair. When this refractory is in poor condition the fuel and air do not mix thoroughly. This condition causes flame impingement, incomplete combustion and carbon deposits.

Insufficient combustion air produces black smoke, which is nothing more than a large amount of unburned carbon in particle form. Check air registers. Use 5 to 15% excess air with steam and mechanical-atomizer burners.

Use an oil temperature of 180 F for steam-atomizing burners; mechanical-atomizing units require a temperature of about 215F.

Be sure to use soot blowers regularly to keep boiler surfaces clean. Some plants blow soot every time a large load change takes place and when flue-gas temperature rises 40 F between blowing periods.

A J BREUGELMANS *New York, N. Y.*

**DIRTY ATOMIZERS** give streaks of oil that pass out stack only partially consumed, even with excess air. The excess air entering around the oil cone cools the flame, delaying combustion until the oil reaches the back of the furnace. Oil particles then strike furnace bottom and side walls.

The most important factor in oil firing is good maintenance of burners. Check for wear caused by abrasive ash and carbon buildup. Rotary-cup burners

(*Continued on page* 140)

# NEW SOLNUS OILS GIVE YOU MORE LUBRICATION PER DOLLAR

## *New Multimillion-Dollar Plant Producing Better General Lubricants at Moderate Prices*

**They can be used for lubrication** of plain bearings, antifriction bearings, linkages, slides, cams and gears; in gear boxes, hydraulic systems, circulating systems, industrial diesel engines, compressors.

**They can be used for longer periods** because they resist oxidation, prevent rusting and corrosion.

**They can be applied by every method** used in the general lubrication of industrial machinery.

**They have low carbon content** In compressors, for instance, any carbon that does form is soft and fluffy, is easily blown off, does not build up.

For technical bulletins, call your nearest Sun office or write SUN OIL COMPANY, Philadelphia 3, Pa., Dept. P-2.

**INDUSTRIAL PRODUCTS DEPARTMENT**
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# More PLANT PROBLEMS

Begins on page 136

with worn rims give poor atomization. Keep cup free of gummy oil deposits. Fuel-oil additives containing combustion catalysts improve combustion appreciably, minimizing soot and slag deposits.

Other causes of *HW's* troubles may be gas stratification, lack of complete blending of oil and air, excessive flame length from insufficient air, fire too close to boiler, too much oil entering furnace, preheating temperature too high, insufficient draft, cold ignition arches or any holes in the baffles.

L W FITZPATRICK
*Jefferson City, Mo.*

**LIGHT FUEL** blended with No. 6 oil may help cure *HW's* carbon troubles. We tried this trick several years ago in my plant. Light fuel was burned when lighting fires under a cold boiler; we fed this to the burners until boiler went on line. Then we switched to No. 6. Results have been excellent.

A separate tank is needed for storage of the light oil. Interconnect suitable piping to the existing No. 6 lines. Light oil may also be used for night and weekend firing.

ART BELTON *Montreal, Canada*

**SMALL COMBUSTION SPACE** and lack of thorough mixing of gas in furnace may cause *HW's* trouble. To obtain best results, oil must be completely burned while in suspension. Most hrt boilers are too low to burn bituminous coal. If later converted to oil firing, they are not high enough for best combustion of heavy fuel. Large combustion chambers entail no heat loss other than radiation if they are air tight.

IRA BUTCHER *Cincinnati, Ohio*

**HIGH CARBON RESIDUE** or improper combustion causes *HW's* condition, despite satisfactory draft, $CO_2$ and stack temperature. Blending will reduce residue in No. 6 oil if No. 2 oil is used for this purpose because the lighter oil has extremely little carbon residue.

Burners that are not correctly centered can throw atomized oil against the furnace side, causing carbon to form. Deposits formed emerge from stack. Excessive preheating can cause thermal cracking of the oil, greatly increasing the carbon residue. Not enough preheating leads to carbonization, increasing carbon discharged by stack.

GORDON WHITTAKER
*Kansas City, Mo.*

**ANALYZE EACH LOAD** of oil received, if possible. Or have your oil supplier do this. Variations in the ultimate analysis of the fuel may cause *HW's* troubles. Burners suited for fuel having one analysis may not perform as well with fuel having another.

$CO_2$ and stack readings taken intermittently do not give a complete picture of conditions within the furnace. Continuous readings, taken for a period of at least one week, will show exactly what happens in the furnace during this time. Then a true study can be made.

Best atomization of oil is obtained when the air is introduced concentric with the fuel. If oil viscosity is higher than that for which burners were designed, atomization is not good. Combustion is incomplete, leading to soot and carbon formation.

Regular and adequate cleaning of oil-fired furnaces is needed to remove carbon deposits. Without the right kind of cleaning, these deposits can build up. Should firing rate be suddenly increased, the rapid introduction of fuel and air creates high-velocity gas streams leading to soot discharge from the stack.

H B WAYNE *Brooklyn, N. Y.*

**SHORT STACK** may cause carbon to be more noticeable in *HW's* neighborhood than a tall one. He might find that a suitable separator could cure his headache completely.

Of course, poor combustion may be his major trouble. This can usually be traced to the fuel, firing-equipment operation or unfavorable atmospheric conditions in the plant area.

LEROY KING *Himrod, N. Y.*

**TOO MUCH EXCESS AIR** chills furnace, causing carbon deposits. *HW* should check the adjustment of his instruments. He may find that their readings are somewhat inaccurate. So-called soot or carbon eradicators may help him because they ignite the carbon, ridding the furnace of build-ups. He may get some help from his smoke inspector, if he asks for it. This often pays off.

HENRY RASMUSSEN
*Crystal Lake, Ill.*

**POWER**

**Modernization Awards**

**For entry procedure, see page 100**

## YOUR NEW PROBLEMS FOR FEBRUARY

### 1 How Can We Clean Our Plant Stacks?

**Our industrial power plant has two stacks. One is steel, the other radial brick. Both are 180 ft high and have an ID of 8 ft at the outlet. Each is equipped with a dust collector.**

**Recent inspections of these stacks show the interiors are extremely dirty. The walls have a thick coating of soot.**

**What we'd like to learn from *Power* readers is how we can clean the insides of these stacks. What is a good cleaning method? Is any rigging or staging needed for cleaning? If so, what is the safest way of setting it up? About how long does it take to clean stacks of this size? Is there any difference in cleaning methods for steel and brick stacks?—*GG***

### 2 Can We Reconnect a Dc Generator?

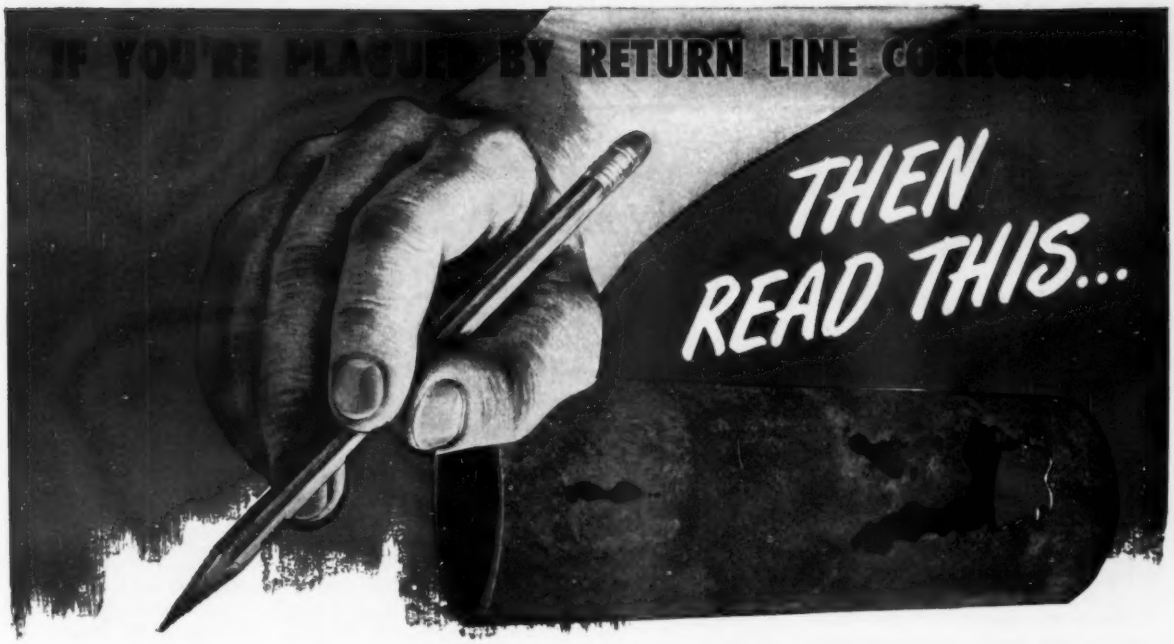
**We have a 120-v dc generator that we'd like to use for a group of new motors we intend to install. These motors will be 240-v dc.**

**Generator has four poles with 56 coils in the armature and 56 segments in the commutator. The coils are grouped in a 4-circuit winding.**

**How can we regroup the field and armature coils to give the higher voltage? Will the generator give satisfactory output if we make such a change? Will generator output be affected in any way? What can I do if the field coils are now in series?**

**Since we are doubling the voltage across the brushes, will we get flashovers?—*JS***

*Will you help readers who sent us problems? Extra pay for photos or sketches.*




As an engineer responsible for efficient, economical plant operation, you know only too well that corrosion of steam and condensate lines can send costs skyrocketing through pipe replacement, interrupted production, and increased labor and maintenance. Perhaps you, like many other engineers, have tried stop-gap methods to check the problem only to find them partially effective or far too costly.

Realizing the importance of this major industrial problem, Betz Laboratories has developed its patented filming amine treatment. Here, at last, is a simple, inexpensive, and practically 100% effective method of eliminating this costly and production-disrupting headache.

For example, a linoleum company, operating at 150 psi and producing 300,000 pounds of steam per day, employed sodium zeolite softening for a high bicarbonate raw water. The carbon dioxide content of the steam averaged 40 ppm. Continued maintenance was required due to failure of condensate lines from the steam kettles and unit heaters. After the filming amine treatment was applied, maintenance records showed an annual saving of approximately $8,000.00! And, a large part of this saving was obtained by eliminating weekend over-time work on pipe replacements.

Why not take the first step toward ridding your plant of corrosion *now?* Call in a Betz Engineer. Ask him to show you how Betz *Specialized* Water Conditioning Service can help you . . . quickly . . . economically . . . effectively. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

*See for yourself how Betz filming amine treatment eliminates return line corrosion and reduces operating costs. Send for Technical Bulletin No. 124.*

**BETZ**

CONSULTANTS ON ALL WATER PROBLEMS

# ARGUMENTS

***Wanted: Your comments on these or any other interesting or controversial subjects. Send in a letter***

## Why This? . . .

IN OUR SHIP YARD we open and repair many turbines each year. We approach a job with great care and thoroughly examine interiors of all machines. Clearances are measured before and after each overhaul. Turbine rotors and blades are inspected using magnetic powder or fluorescent die methods.

Your article "Let's Inspect and Overhaul Your Steam Turbine Now," November POWER, shows maintenance men using asbestos string in the turbine joint. Our practice does not allow such sealing devices. We blue and scrape the metal

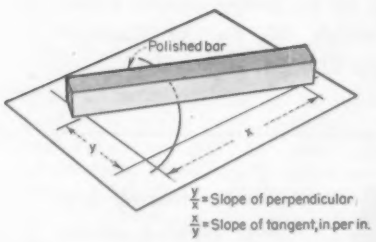
## When This Will Do?

to virtually 100% contact before making up casing joints.

I am particularly interested in the asbestos string, and would appreciate more information about its use.

C M FIXMAN *San Francisco, Calif.*

ED. NOTE: *While bluing and scraping give a good seal, are they necessary? One turbine manufacturer recommends asbestos string for service up to 1200 psi, 900 F. We welcome readers' opinions of both systems for sealing turbine joints, as well as service experience with them.*




## Use Mirror to Find Slope

THERE ARE BETTER WAYS for finding slope of a curve than the two methods on pages 81 and 222, November POWER.

Perhaps the easiest is to use a mirror held perpendicular to the paper and the curve. A straight metal bar with a polished surface is handy for this purpose. Lay it down at the desired point and swing it around until reflection appears continuous with exposed portion of the curve. Mirror is then perpendicular to a tangent drawn at that point.

Slope of tangent in inches per inch is the ratio x/y, see sketch. Measure distances "x" and "y" from chart graduations. If plotting scales are equal, read slope directly; otherwise, apply ratio of the scale factors.

Conversely, slope of mirror is shown by the ratio y/x. This is the reciprocal of the slope of the curve.

Other methods call for a special instrument that embodies a small triangular prism in a rotating mount with a circular scale of slope. I am told that a satisfactory device can be made by using two parallel pieces of glass rod in a similar mounting.

But the mirror is easy to get and easy to use. I have one and like it.

C H BERRY *Cambridge, Mass.*

## Also Says, 'Use Mirror'

IN THE ARTICLE "How to Pick the Right Pipe Insulation," November POWER, you recommend the arithmetic method for finding slope of the price curve, because graphical solution is often inaccurate.

I recommend using a mirror for this purpose, as suggested by J M Ramrath in the Allis Chalmers' *Review*, 3rd quarter, 1951. [See "Use Mirror to Find . . ." *below, left*, for method.—ED.]

This procedure would improve your accuracy without sacrificing speed.

C D MACY *Austin, Minn.*

## Suggests Dust Hopper to Stop Boiler Vibration

I WAS VERY INTERESTED in the answers submitted to the question "How Can We Stop Boiler Vibration?" (page 158, October POWER). It seems to me that all the answers submitted have missed the boat. A smoke inspector on his toes should have caught this condition long ago.

I am sure the problem results from flue dust accumulating in the breeching. I have seen such conditions where flue dust filled up a 5-ft breeching to better than 3 ft deep, causing a real restriction in gas travel.

This could result in a pulsating condition, causing vibration. It would naturally overcome itself in time and the flyash would eventually deposit in the stack base or fly out the top.

Placing a dust hopper on bottom of breeching where flue dust accumulates would overcome the problem.

H J SCOTT *Cleveland, Ohio.*

## Piping Systems Need Color Coding

PIPING SYSTEMS in power plants should be color coded to simplify operation and eliminate guess work.

One plant I know of used adhesive arrows to mark the direction of flow. Perhaps the arrows were meant to be temporary, but they were in place over a year. In time some fell off and were never replaced, or they were put back haphazardly so several pointed the wrong way.

Other plants leave too much to the memory of the watch engineer, who may forget the exact use for seldom-used valves. A color code would largely eliminate this. In addition, it would make tracing lines much easier.

On extraction steam lines where the same color would be used, paint the stage number in large figures near stop valves. Where line exhausts into a heater or evaporator and where there are steam traps, paint line number again.

Mark direction of flow and label all lines. If there is any doubt about what an auxiliary is, label it too. In fact, it wouldn't hurt to label all equipment.

H CONGDON *Beloit, Wis.*

# PHYSICS . . In one easy lesson

## or why *LEVERAGE* is a good invention

Reprinted from the No. 3, 1948, issue of the Armstrong Trap Magazine

A BURLY giant, whom we shall call Dullbottom for lack of a more descriptive name, was amusing himself in the Petrified Forest one warm July afternoon. Entranced by the many colorful and giant-sized playthings there, he was happily engaged in rolling petrified logs down a small incline when one toppled onto his toe. Despite his most persistent efforts he was unable to dislodge this log, later calculated by Unimpeachable Authorities to weigh 1,000 lbs.

Dullbottom's gruntings and groanings attracted a petite and pretty Physics teacher who (fortunately for our story) was strolling in the vicinity. It took her but a glance to grasp the situation and, without hesitation, she obtained a crowbar from a convenient source of supply, applied LEVERAGE to the log and freed the giant's giant toe.

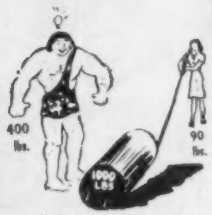
Completely befuddled by the powers of his 90 lb. benefactor, but clumsily grateful, he asked to feel her muscle, a request which was instantly refused. Instead, the young lady offered to explain the fundamentals of LEVERAGE. Delighted by her explanation, that given sufficient LEVERAGE, she could move any weight, Dullbottom immediately proceeded to roll a 4,000 lb. petrified log onto his other foot.

With the infinite patience acquired from dealing with adolescents in the classroom, our pretty Miss obligingly procured another crowbar four times as long as the first and proceeded to move the weight—BUT, much to the dismay of Dullbottom, only ¼ as far, which was, sad to relate, not far enough to free his toe.

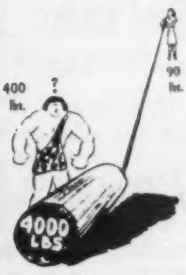
And, thereby, hangs a tale. Let's use this little flight of fantasy to explain a fundamental reason why Armstrong steam traps have such large capacity for their size. Please refer to diagrams on the blackboard.

### *The Fairy Story*

1. All Brawn . . . No Brains




2. Science to the Rescue




3. Stupidity Triumphant

### No Leverage

To open a 1-1/16" orifice at 15 psi, a steam trap without leverage would require a bucket weighing 19-1/2 lbs. and displacing 29-1/4 lbs. of water. A trap big enough to hold this bucket would weigh somewhere near 300 lbs. At 250 psi, the largest orifice this trap could open would be 9/32".

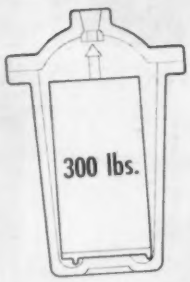
### Correct Leverage

Contrast the No-Lever Trap with an Armstrong No. 216 weighing about 1/4 as much . . . 80 lbs. It also opens a 1-1/16" orifice at 15 psi and will open a 3/8" orifice wide at 250 psi — nearly 80% greater than that of the No-Lever Trap. Result of CORRECT LEVERAGE: less weight, less radiation, lower price trap, less installation cost, greater capacity.

### Too Much Leverage

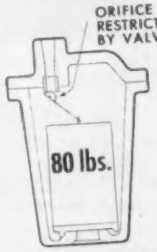
Here's an 80 lb. trap with leverage double that of the No. 216 Armstrong described above. It will open an appreciably larger orifice at any given pressure than the standard Armstrong No. 216. *But, it won't open the valve wide!* There isn't room to get the valve completely away from its seat. Flow through the orifice is thereby restricted and capacity is reduced below that of the No. 216. The larger orifice and the greater leverage is a total loss! To get the valve wide open would require a bigger trap.

### *The Real Thing*




Get Results . . . But Impractical

Efficiency, Economy



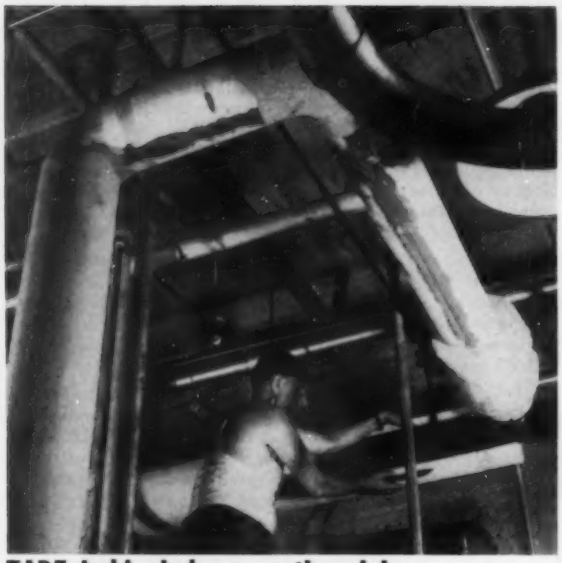

Misapplied Science

**ARMSTRONG MACHINE WORKS**
**812 Maple Street**
**Three Rivers, Michigan**

*Send for Catalog*

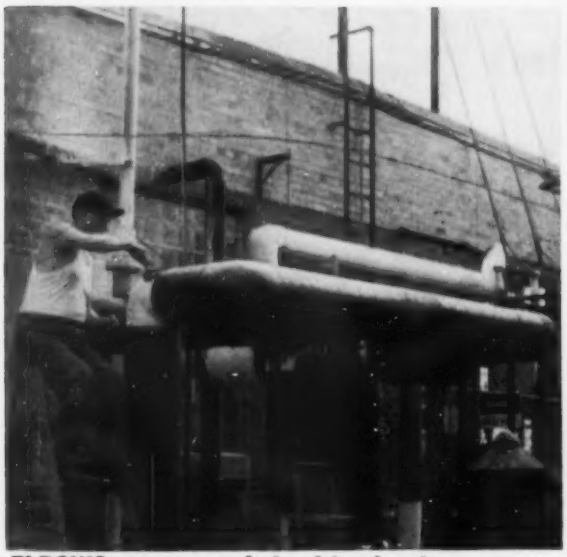
Size for Size, Armstrongs have greater capacity because the correct application of high leverage permits the full opening of a large orifice!

# ARMSTRONG STEAM TRAPS

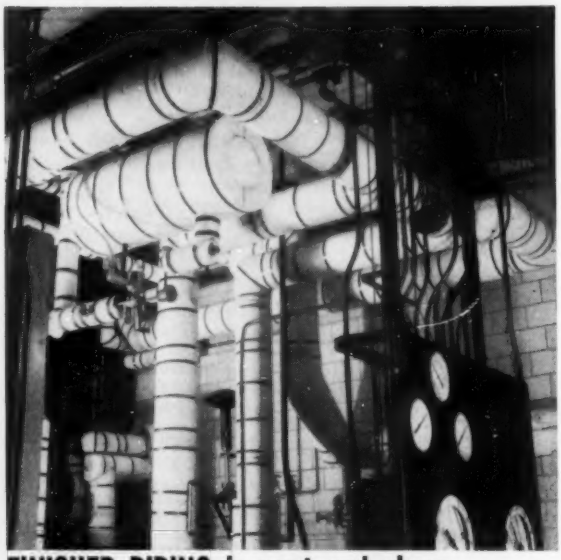


TAPE holds halves on the piping...

ROOFING FELT makes weather coating...



ELBOWS are troweled with plastic...



FINISHED PIPING is neat and clean

# HOW TO
## Insulate With Styrofoam

*Courtesy, Dow Chemical Co, Midland, Mich.*

► THIS EXPANDED POLYSTYRENE, Styrofoam, has most characteristics needed for low-temperature insulation. Use below 175 F as it's a thermoplastic and may deform at higher temperatures.

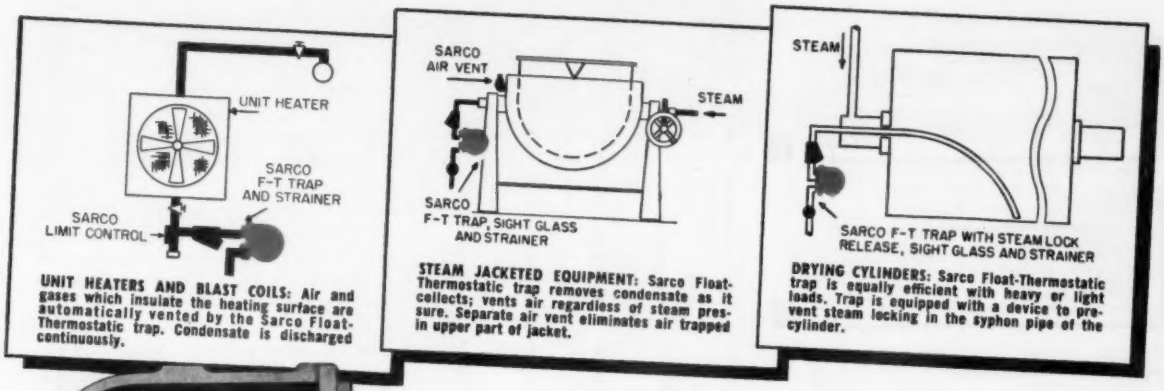
Thermal conductivity is low, with K factor 0.23 to 0.30 Btu per sq ft per hr, per deg F, per in. at mean temperature of 40 F. Original insulating value is retained over long period because of low moisture absorption. Average compressive strength is 20 lb per sq in. It can be cut and handled because it is nondusting and nonflaking—does not delaminate, or fall apart in service.

Resistance to rot or fungus growth is high—it's an excellent vapor barrier, too. Water does not swell or soften it, and water pickup is only 2 to 6% by volume. In this lightest of all rigid-type insulation materials, density is 1.3 to 2.0 lb per cu ft. It's nonirritating to skin—odorless qualities make it good material for food-processing plants.

For operating temperature of 35 to 45 F, use 3 in. thick; 25 to 35 F, 4 in.; 5 to 20 F, 5 in.; –5 to 5 F, 6 in.; –20 to –5 F, 8 in. Write maker for data.

# Is this your TRAPPING PROBLEM?

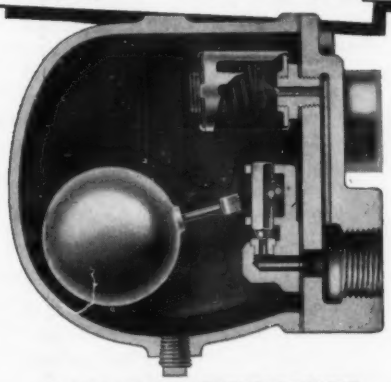
***How to get:***
**maximum heat transfer over entire heating surface under varying condensate loads and steam pressures**


UNIT HEATER
SARCO F-T TRAP AND STRAINER
SARCO LIMIT CONTROL
SARCO AIR VENT
STEAM
SARCO F-T TRAP, SIGHT GLASS AND STRAINER
STEAM
SARCO F-T TRAP WITH STEAM LOCK RELEASE, SIGHT GLASS AND STRAINER

**UNIT HEATERS AND BLAST COILS:** Air and gases which insulate the heating surface are automatically vented by the Sarco Float-Thermostatic trap. Condensate is discharged continuously.

**STEAM JACKETED EQUIPMENT:** Sarco Float-Thermostatic trap removes condensate as it collects; vents air regardless of steam pressure. Separate air vent eliminates air trapped in upper part of jacket.

**DRYING CYLINDERS:** Sarco Float-Thermostatic trap is equally efficient with heavy or light loads. Trap is equipped with a device to prevent steam locking in the syphon pipe of the cylinder.



**SARCO FLOAT-THERMOSTATIC STEAM TRAP**

Sizes ¾" to 2½". For complete specifications send for Bulletin 450.

## *How to select the right trap*

There is no universal steam trap. For efficient trapping always match the characteristics of the trap to the requirements of the job.

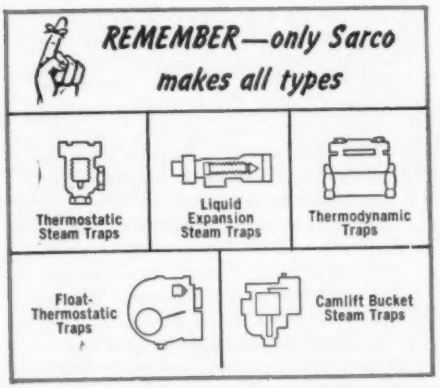
The characteristics of the Sarco Float-Thermostatic trap, for example, are:

1. Discharges condensate continuously at steam temperature.
2. Responds immediately to varying loads and pressures.
3. Automatically vents air on start-up and during operation.
4. Does not cause pressure pulsations which disturb temperature control.

Whatever your trapping needs may be, there's one type trap that will do the job better than any other. Only Sarco makes *all* types – you can always choose a Sarco trap best suited to your job.

**HELPFUL BULLETIN:** "Selecting the Right TYPE Steam Trap" can help you. It gives characteristics of each type of trap and shows which type to use on various installations. Send for Bulletin 145.

**ENGINEERING SERVICE:** You can obtain impartial advice on your trapping problems from Sarco Engineers. Sarco makes *all types* of steam traps – favors no one type. Whenever you need help, call your local Sarco representative.



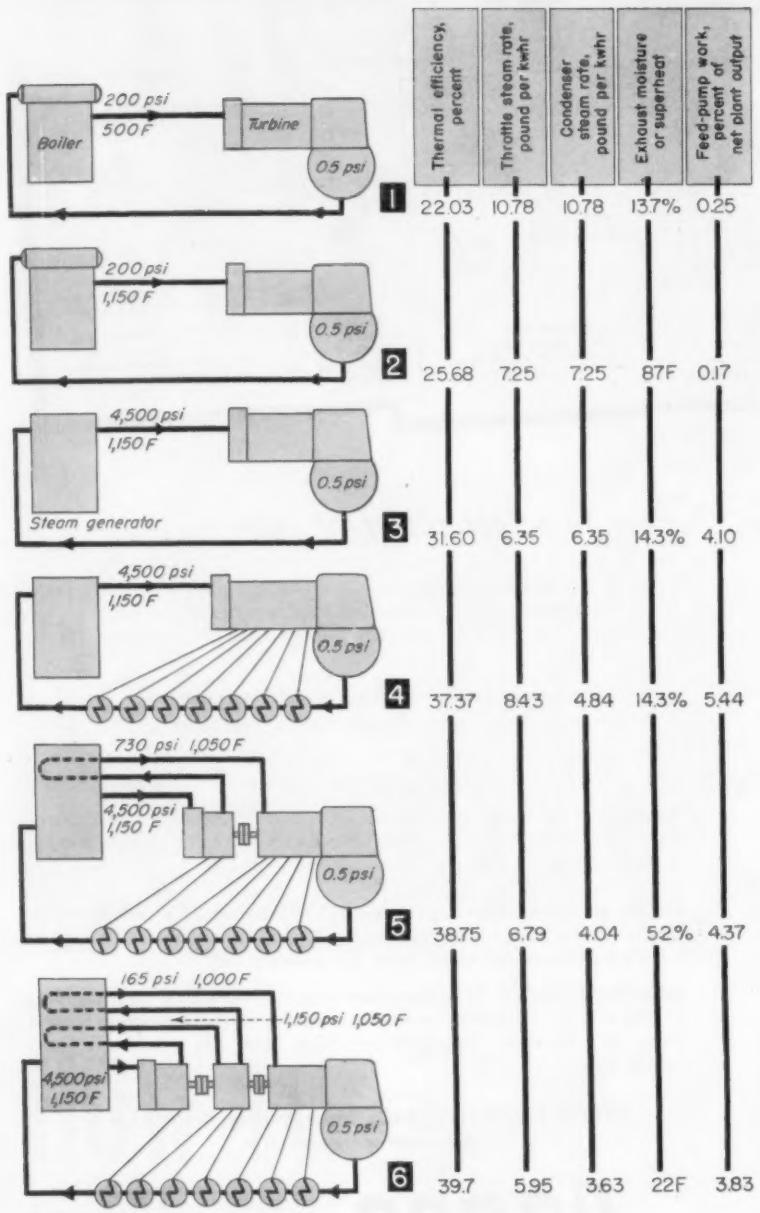

**SARCO COMPANY, INC.,** Empire State Bldg., New York 1, N. Y.
*Represented in Principal Cities*

**SARCO** *improves product quality and output*

STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES

# HEADWORK

## PHIL SWAIN BRINGS ENGINEERING THEORY DOWN TO EARTH




# The ABC of Superpressure—5

► THE SIX CYCLES on this page show how you can boost the thermal efficiency of a power plant in four ways: (1) increasing the steam temperature (2) increasing steam pressure (3) stage feedwater heating and (4) reheating the steam. The last is worthwhile only with high pressures.

The accompanying sketches and data are based on the report Associate Editor Ben Skrotzki published in September POWER. Read his article if you want a more detailed scientific explanation.

Here are some of the main points:

In all cases pictured, boiler and reheat efficiency is taken as 85%, turbine efficiency 80% and condenser pressure 1 in. mercury, absolute (equals 0.5 psi abs). Pressures are psi absolute.

In Cycle 1 we start with steam at 200 psi and 500 F, and no feed heating. Thermal efficiency of plant: 22.03%.

This rises to 25.68% when steam temperature goes to 1150 F in Cycle 2.

Next, boost throttle pressure to 4500 psi, Cycle 3. Thermal efficiency rises to 31.6%. Adding seven stages of bleeder feed heating, Cycle 4, gives another big lift to 37.37%. Finally, in Cycles 5 and 6, we reach 38.75% with single reheat and 39.7% with double reheat.

One requirement of superpressure is the added power required for feedwater pumping. In Cycle 4 this amounts to 5.44% of the net plant output. Note that this feed-pump power has already been deducted in preparing the listed thermal efficiencies.

For a given pressure the feed-pump work is directly proportional to the weight of feedwater going to the steam generator. This, in turn, equals the weight of steam delivered to the turbine throttle. Reheating (Cycles 5 and 6) allows each pound to do more work, so reduces throttle steam and pump power.

In required condenser capacity, it is interesting to compare the two extremes, Cycles 1 and 6. For a plant of given kilowatt capacity, Cycle 1 requires nearly three times as much capacity in condensers and circulating pumps.

High-pressure designs reduce investment in condensing equipment, but boost the cost of feed pumps and higher-stage feedwater heaters.

# for lower cost control of moderately **Corrosive** fluids

Fig. 2651-A Gate

**JENKINS**

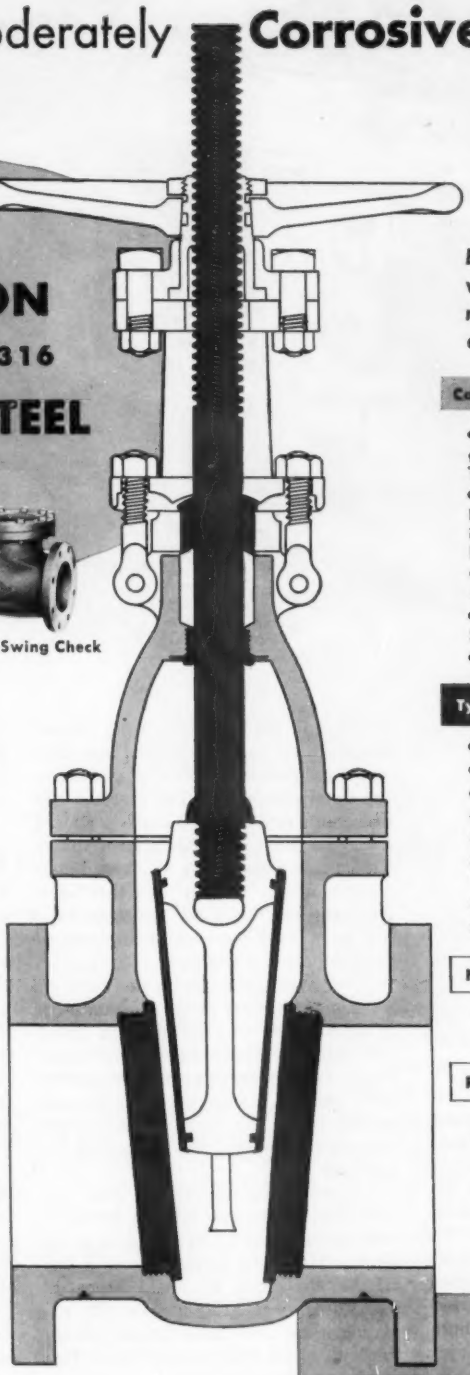
## NICKEL IRON

**Valves with Type 316**

## STAINLESS STEEL

**Trim**

Fig. 2624 Swing Check



***Every part in contact with fluid is the right metal to block corrosion and beat wear.***

**Cast NICKEL IRON**

- **BODIES** Heavy duty, dimensioned for greater resistance to wear and abuse. Through port design in Gate Valves.
- **BONNET** Rugged construction, like body. Swing-type gland bolts. Screwed-in back-seating bushing. Deep stuffing box.
- **YOKE** Integral with bonnet in 2″ to 4″ sizes.
- **WEDGE** In 10″ to 24″ sizes, with Stainless Steel Wedge Rings.
- **COVER** In Check Valve.

**Type 316 STAINLESS STEEL**

- SPINDLE
- GLAND
- BONNET BUSHING
- SPINDLE RING
- WEDGE PIN
- WEDGE RINGS Rolled into Nickel Iron Wedge in 10″ to 24″ sizes.
- SEAT RINGS
- DISC and HANGER in Gate Valve

**NI-RESIST Type No. 2**

- WEDGE of I-beam structure is solid NI-RESIST in 2″ to 8″ sizes.

**PRESSURE RATINGS**

2″ to 12″—200 lbs. O.W.G.
14″ to 24″—150 lbs. O.W.G.

This combination provides corrosion resistance well above the moderate need in many processing services with an investment well below that for all-stainless steel valves.

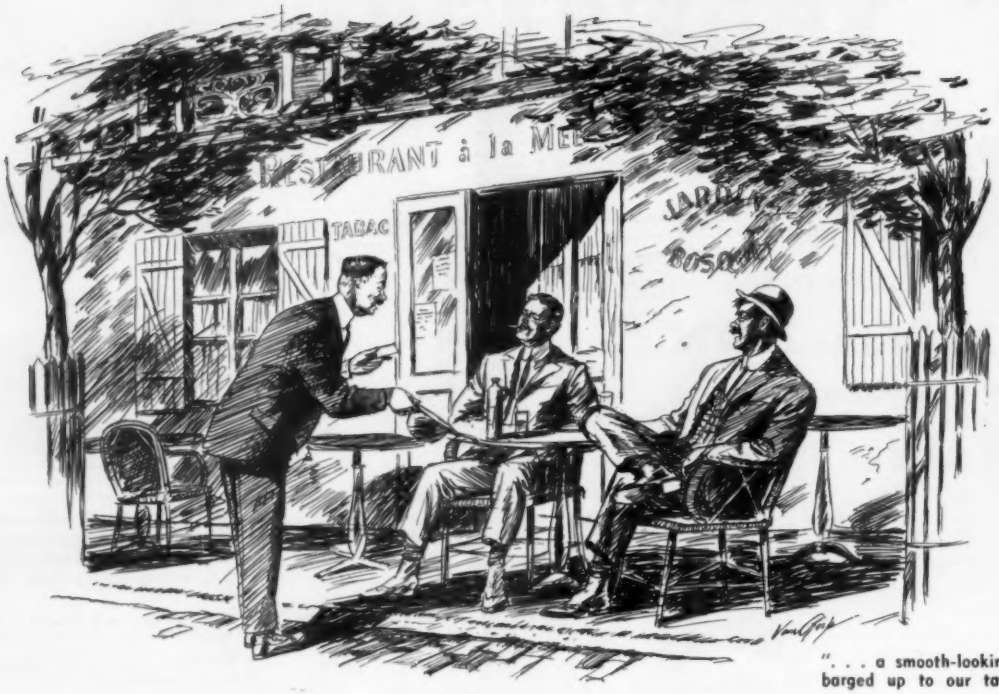
Designed primarily for the chemical process industries, they are recommended for control of mildly corrosive liquids with minimum quantities of mineral acids, such as creosote in wood treatment, and many liquids carried in petroleum processing.

A major use is in pulp and paper processing, particularly in lines serving the digester, and in the chemical recovery cycle. Service records in lines carrying the valve-punishing "black liquor" give Jenkins Nickel Iron Valves top performance rating.

Jenkins *extra value* construction throughout. Get details — compare. See why they stretch your valve investment dollar — with longer service life, lower maintenance cost.

**GET COMPLETE SPECIFICATIONS from your Jenkins Valve Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17. Ask for Bulletin 118.**

JENKINS
LOOK FOR THE DIAMOND MARK
VALVES
SINCE 1864 TRADE JENKINS MARK
Jenkins Bros.




". . . a smooth-looking German barged up to our table . . ."

# Marmy's Fish Merchants

► "BILGEWATER ON POWER PLANT RACKETEERS," roared Marmaduke Surfaceblow into his telephone when I entered his dingy office above O'Houlihan's Machine Shop & Engine Works this morning. "And remember," he warned, "No ship can sail in two directions at the same time." With that he slammed down the receiver and worked up two inches of forced draft on his cigar butt.

After I stopped coughing and my eyes stopped watering, I was able to ask, "What's all the shooting, Mr Surfaceblow?" The old consulting engineer just puffed away and stared out the window at a passing ship. Then without warning he gave his old gray bowler a starboard list, anchored himself firmly in his swivel chair, propped his feet up on his desk and started sounding off.

"Back in 1910 I was fireroom Second Assistant on the old *SS LaPlata*. She was a reciprocating job with coal-burning watertube-boilers. The fireroom had been run down, but after one trip aboard I had the boilers in fairly good shape. The engine room was a wreck and kept getting worse. Reason was the Chief Engineer and his First Assistant were too busy working rackets in port to overhaul their machinery.

"One night in Antwerp the three of us dropped anchor at the Restaurant a la mere Catherine for a cargo of liquid refreshments. About the time our cargo booms were limbered up and doing some fancy hoisting, a smooth-looking German barged up to our table and asked the captain if he wasn't the skipper of the *LaPlata*.

"'Sure,' answered the old man suspiciously, 'what about it?' The foreigner introduced himself and told him a pet shop in Hamburg, Germany would buy all the angle fish we could bring up from Brazil—at $100 a pair. He explained these are small, bright, silvery fish with broad dark vertical bands that disappear when the fish are not among plants. Angle fish are so thin they can hide behind a slender plant stem. But they're nervous and, in captivity often dash themselves dizzy against the tank's side. Also, they need plenty of other attention, like keeping the water between 75 and 85 degrees.

"Although they're sold in pet shops in great numbers today, they were introduced into Europe only two years before, in 1908, and became a sensation overnight.

"The old man wasn't sold until the German told him he could clear several thousand dollars on our next trip from Brazil. In those days that was about a year's pay for a skipper.

"'I'll gamble by putting up the money if you'll look after the fish,' the skipper propositioned the First. 'And we'll split the profit,' he added. They shook hands. The German wrote down the supplier's name to contact in Pernambuco, Brazil. He also wrote out feeding and caring instructions and said he'd cable ahead for a thousand fish to be ready on our arrival.

"On our trip home from Antwerp to Boston, the Chief requisitioned stores for building an aquarium. Then on the trip south from Boston, the First and his men spent their time building the tank—instead of trying to run efficient sea watches down below.

"A few days out of port the air pump gave up the ghost. So the First stationed a wiper to stand by to tap the valvechest with a hammer every time it stopped. Nearing the coast of Brazil, both the main and auxiliary reciprocating feed-pumps had to be run parallel so when one stopped the other would jar it into making another stroke. The main engine also hadn't been keyed up

(*Continued on page* 198)

Photomicrograph of one type of silica scale in early formation stage. Further deposits will fill in between the "trees" to form a dense, glass-hard, insulating covering that is extremely difficult to remove—and impervious to usual water treatment techniques.

# *(The boiler scale that fought back)*

● When silica scale was mentioned, water-treatment experts used to change the subject quickly . . . until a plant using The Nalco System began having scaling troubles due to high silica content of the raw water.

That was many years ago. Today, the same plant, operating at 135 psi, maintains 500 ppm (29.4 grains per gallon) silica in boiler water without scaling.

The Nalco research program that solved this low-pressure boiler water silica problem is a continuous one, so that today The Nalco System successfully meets the challenge of silica wherever it arises in the field of water conditioning.

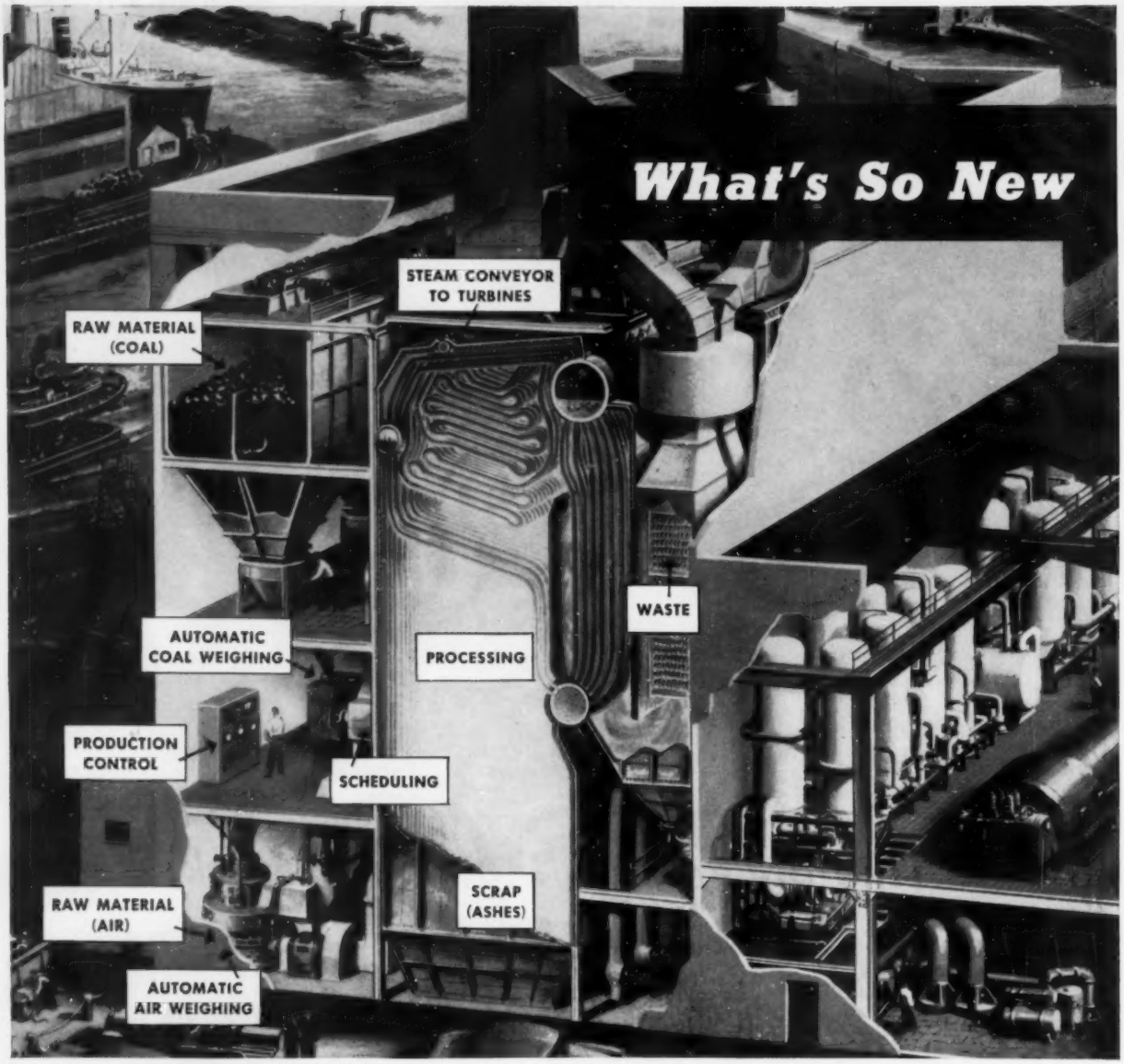
Whether your water treatment problem is silica—or something even tougher—Nalco has the solution, or can put the full facilities of the Nalco Laboratories to work on it for you.

## LATEST STUDY ON SILICA CARRY-OVER

At operating pressures over 400 psi another silica problem—that of silica carry-over—often arises. One of the 1951 ASME papers, "Correlation of Silica Carry-over and Solubility Studies" is an up-to-the-minute, informative discussion of this problem. You are welcome to a copy. Just write to National Aluminate Corporation.

**NATIONAL ALUMINATE CORPORATION**
**6222 W. 66th Place • Chicago 38, Illinois**
*Canadian inquiries should be addressed to*
*Alchem Limited, Burlington, Ontario*

**THE *Nalco*® SYSTEM . . . Serving Industry through Practical Applied Science**




View Courtesy of the Armstrong Cork Company

*This Is How a Factory Man Might Look at a Power Plant*

That's because, in most plants, it's a completely automatic manufacturing operation, converting fuel and air into available heat and condensate and make-up water into steam for processes and turbine generators. Instruments and controls make it possible to achieve the full efficiency that has been built into the modern power plant.

**REPUBLIC FLOW METERS CO.**

# About Automatic Factories?

## . . . Power "Factories" Have Been Operated Automatically for Years!

THEY say it's coming — automatic production of automobiles, appliances and the thousands of other things we need and use. It's a startling thought, this idea of factories that will need only human supervision and maintenance and nothing more.

Yet, when you look at your own power plant, the idea doesn't seem so new after all. For power plants are actually factories. They produce products — steam and electricity — that are distributed, sold and used by millions daily.

### PIONEERS OF AUTOMATIC FACTORIES

It is the power industry that has actually pioneered automatic factories. Almost 30 years ago the first power plant was operated entirely by automatic controls. Control principles learned from this and thousands of subsequent installations are guiding today's designers of the factories of tomorrow.

The Smoot Engineering Corporation, which made this first control installation, was acquired by Republic Flow Meters Co. some 20 years ago. Since then, Republic has carried on the Smoot leadership in the automatic operation of power plants, manufacturing a complete line of instruments and controls for this purpose. For example, a recent Republic development, the Electronic Telemaster, has made possible the control of large boilers where components are so distant that transmission lags in ordinary control systems would prohibit automatic operation.

With this wealth of past experience and an active development program to guide them, Republic engineers are able to give you the latest features in control systems to best meet your present and *future* needs.

**REPUBLIC Automatic COMBUSTION CONTROLS**

- For all types and sizes of boilers
- For all arrangements of draft
- For all types of fuel firing
- For all load conditions

SHERMAN CREEK STATION

***WHERE AUTOMATIC POWER PLANT OPERATION WAS FIRST PROVED PRACTICAL . . . 30 YEARS AGO!***

**In 1922, Smoot Controls (now incorporated into the Republic line of instruments and controls) were installed on four boilers at New York's Sherman Creek Station in an experiment to test the feasability of controlling combustion automatically. Within five months, the superior performance of boilers with these controls was so conclusively demonstrated that the entire plant, consisting of 44 boilers, was equipped with Smoot Controls. After this test proved it was practical to control boilers with other machines, it was only a short time before automatic boiler controls were installed in scores of power plants all over the country.**

**2240 Diversey Parkway • Chicago 47, Illinois**

# Speaking of power

## personal slants on doings of interest to power men—some significant, some just odd

**Titanium, new wonder metal,** set a 1953 production record of 2250 tons. Doesn't sound like much, but five years ago it was only eight tons. With military demand soaring, present producers – Titanium Metals Corp and Du Pont – are pushing to expand capacity by 300 tons each. When Cramet, Inc, a wholly owned subsidiary of Crane Co, brings in a 6000-ton plant in 1956, total U.S. output will exceed 13,000 tons per year. Even that seems far short of needs, and other producers are planning additional capacity.

Light weight, high strength and extremely good corrosion resistance make more titanium alloys a must for the aircraft industry. And when production expands further and price drops, these qualities will make titanium alloys a natural for some of the power field's tough jobs.

**Outlook for engineers** stays bright even though Northwestern University's annual survey of college-graduate employment shows a slight slackening of demand. Industry's needs in 1954 look to be about 8% higher than in 1953, against an earlier forecast of about 25%.

Experts still expect a long-term shortage of engineers. They figure this way: Only a certain percentage of the population has the basic mental qualities needed. Once we reach a point where all able youngsters are being trained, increase in number of engineers will depend on growth of population. But need for engineers should grow at a faster rate. So engineering stacks up as a good bet for that son of yours, if he's got the stuff.

**Power-tight Northwest** will just about get by until 1960 if all present construction stays on schedule. But substantial deficits loom after 1960, says a Bonneville Power Administration study of long-range needs.

As one answer to the need, six major private power companies plan to set up a joint corporation to build new dams on the Columbia and its tributaries. They are: Montana Power Co, Idaho Power Co, Mountain States Power Co, Washington Water Power Co, Pacific Power & Light Co, Portland General Electric Co.

**World's tallest stacks?** That's what a reader wanted to know about those at Clifty Creek, the 1,200,000-kw plant that, with the nearby 1,000,000-kw Kyger Creek plant, will supply the giant atomic-energy facility at Portsmouth, Ohio. At 680 ft above grade, Clifty Creek's stacks look like the new titleholders.

According to Custodis Construction Co, world-renowned chimney builders, three of the world's tallest belong to American Smelting and Refining Corp: 606 ft at El Paso, 600 ft at Selby, Calif., and 571 ft at Tacoma. The 585-ft stack at Anaconda Copper's Montana plant rounds out today's "big five".

**Water a million years old** feeds the boilers at the big U.S. Thule base, which nestles under Greenland's glaciers. And, says former Power contributor John Shotwell, who's been commuting between New York and Thule, one of the local bars advertises "All ice in drinks served at this bar is made from water more than a million years old." He reports that age doesn't seem to spoil water as a solvent for alcohol, nor as the makings of steam.

Leo Lowley

# HALL INDUSTRIAL WATER REPORT

*Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.*

Volume 2 | FEBRUARY 1954 | Number 1


## *Amine Film Reduces Condensate Corrosion by More Than 90%*

In a plant manufacturing electrical equipment, carbon dioxide and oxygen in the steam condensate were causing numerous piping failures. Corrosion products plugged lines and caused poor space heating by depositing in the heaters and by interfering with trap operation.

The Hall field service engineer recommended that the film-forming corrosion inhibitor Hagafilm* be fed to the boilers for distribution throughout the return system.

Treatment was started during the cold season and by spring all old deposits were cleaned out of the lines and failures were negligible. Test specimens showed a corrosion reduction of 91 and 92 percent at two locations. Week-end overtime work on the return system was eliminated. Trap maintenance was reduced to practically nothing whereas formerly a man had to be kept constantly on that job. Complaints, which had been commonplace before, disappeared as space heating improved. Substantial savings in equipment and manpower were achieved at moderate cost.

The next year, at the end of the first full cold season with treatment, it was reported that considerably less coal was used than during the previous year. There had been no other changes in operation and the weather was comparable.

During the second full cold season over two years after the start of treatment, the plant reported the only failures were two nipples and one tee which had been installed before the start of inhibitor treatment.

*Hagafilm is a registered trademark.

*Water is your industry's most important raw material. Use it wisely.*

## Hall Engineer "Sees Through" Glass Problem

In this glass factory, maintenance costs were running as high as $75,000 annually. Critical were watercooled "gathering rams," the working ends of which were almost continuously exposed to furnace temperatures of 2,800° to 3,000° F. Deposits and corrosion in the cooling passages had led to overheating and failure.

An investigation by the Hall field service engineer revealed that cooling water flow through the rams was mechanically restricted in places, and that the water feed and discharge lines were poorly arranged and insulated.

Once these defects were corrected, Threshold treatment of cooling water with a few ppm of glassy phosphate proved effective in controlling deposition and corrosion. Now the plant engineer says, "We have forgotten about cooling water altogether."

## *Industrial Water Problems Require Special Handling*

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, P.O. Box 1346, Pittsburgh 30, Pa.

## Hall Field Engineers "Refreshed" in Pittsburgh

Hall field engineers recently spent a week in Pittsburgh attending an annual refresher course. Twenty sessions were devoted to discussions of the latest technological advances in the field of water conditioning and the engineering solution of specific water problems.

A major purpose of the course was to provide an exchange of information regarding actual situations encountered by Hall field engineers in many different types of industrial plants.

## Conductivity Tests Streamlined With New Flow Cell

Hall research engineers have simplified testing for dissolved solids in an eastern utility plant's condensate and feedwater system by development of a new flow cell used in conjunction with an electrical conductivity meter. The compact unit is less than 10" long, and the cell itself is so small that there is practically no holdup to level out differences in conductivity.

One of the advantages evident in use is the ease of removal and installation of the conductivity cell when cleaning or inspection is required. The operator takes the assembly apart quickly and easily because of a specially designed flexible coupling with rubber "O" rings and back-off nuts. A bimetallic dial-reading thermometer is a standard part of the assembly. Aside from the glass cell itself, the principal "wet" components are made of stainless steel.


HALL LABORATORIES, INC.—CONSULTANTS ON PROCUREMENT, TREATMENT, USE AND DISPOSAL OF INDUSTRIAL WATER

(Advertisement)

# READER SERVICE SECTION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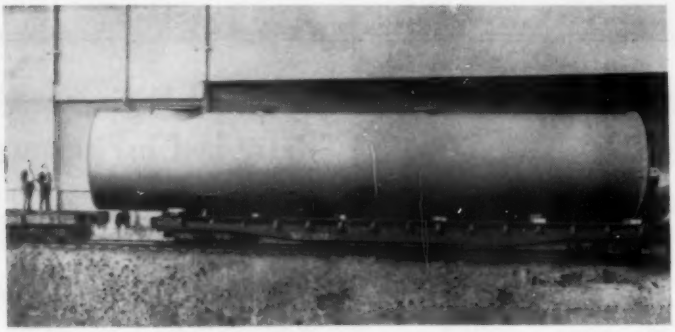
NEW FREE BULLETINS_____169

**The World's Largest Silencer**

Here is what is believed to be the largest silencer ever built. It measures 74 ft in length, 12 ft in diameter and has an estimated weight of 70,000 lb. Designed and built by Burgess-Manning Co of Illinois, unit will silence the exhaust of a 5000-kw simple-cycle gas turbine generating unit of a Midwestern utility.

## Northwest Hydro Moves Ahead

► U. S. CORPS OF ENGINEERS has announced plans for three large power and storage dams in north-central Idaho. These plans are to be included in a revised report on project surveys to be forwarded to Congress.

Bruce Eddy dam and power plant on the north fork of the Clearwater will cost $125-million, produce 244,000 kw and provide 1,430,000 acre-ft of storage. Penn Cliffs on the middle fork of the Clearwater will cost $180-million, generate 292,000 kw and store 2,450,000 acre-ft.

Mountain Sheep on the Snake, above its junction with the Imnaha, will cost $358-million, produce 1,035,000 kw and store 2,450,000 acre-ft. Construction of this last dam is to some degree contingent on the final disposition of the Hell's Canyon project.

These dams will contribute to Columbia River flood control as far as Portland, Ore. Mountain Sheep, if built, will be a Bureau of Reclamation project and will be 565 ft high. It will substitute for the high Hell's Canyon dam if that project shifts to the three-low-dams proposal of Idaho Power Co. Kooskia on the Clearwater with a potential of 440,000 kw and Nezperce on the Snake with a potential of 1,650,000 kw are other possibilities.

The state of Idaho approves of these plans but wants assurance that it will

(*Continued on page* 236)

### Coming Events

**Feb 15—American Society for Testing Materials,** SW District-Joint meeting with NACE, Dallas, Texas. For details write S E Fitterer, ASTM, 1916 Race St, Philadelphia 3, Pa.

**Mar 15-19—National Association of Corrosion Engineers,** 1954 Conference and Exhibition, Kansas City Municipal Auditorium. For details write NACE, 1061 M & M Bldg, Houston 2, Texas.

**April 14-16—Society for Experimental Stress Analysis,** spring meeting, Netherlands Plaza Hotel, Cincinnati, Ohio. For details write H LaTour, chairman SESA, 134 Kensington St, Middletown, Ohio

**May 25-28—National District Heating Assn,** 45th annual meeting, The Greenbrier, White Sulphur Springs, W. Va. For details write J F Collins Jr, secy-treas National District Heating Assn, 827 N Euclid Ave, Pittsburgh, Pa.


**POWER**

**Modernization Awards**

**For entry procedure,**

**see page 100**


## Some Pros and Cons On Atomic Energy

• INTERNATIONAL TALKS on peacetime uses for atomic energy will take place June 20-25, 1954 at University of Michigan. This historic 5-day congress, scheduled just two days after President Eisenhower's U. N. address, represents the first really concrete international effort to solve the dilemma created by this new energy source.

Among those participating in the conference will be 10 foreign nations, 23 American industrial concerns and 12 American educational institutions. U. S. Atomic Energy Commission and Britain's atomic authority are now declassifying information to provide material for the week-long talks.

Although much of the discussion will be of interest primarily to the government, the congress will include a series of sessions of direct interest to the general public. AEC is now exploring the possibilities for including an atomic exposition that would give the American public its first extensive view of peacetime developments in industrial atomic energy applications.

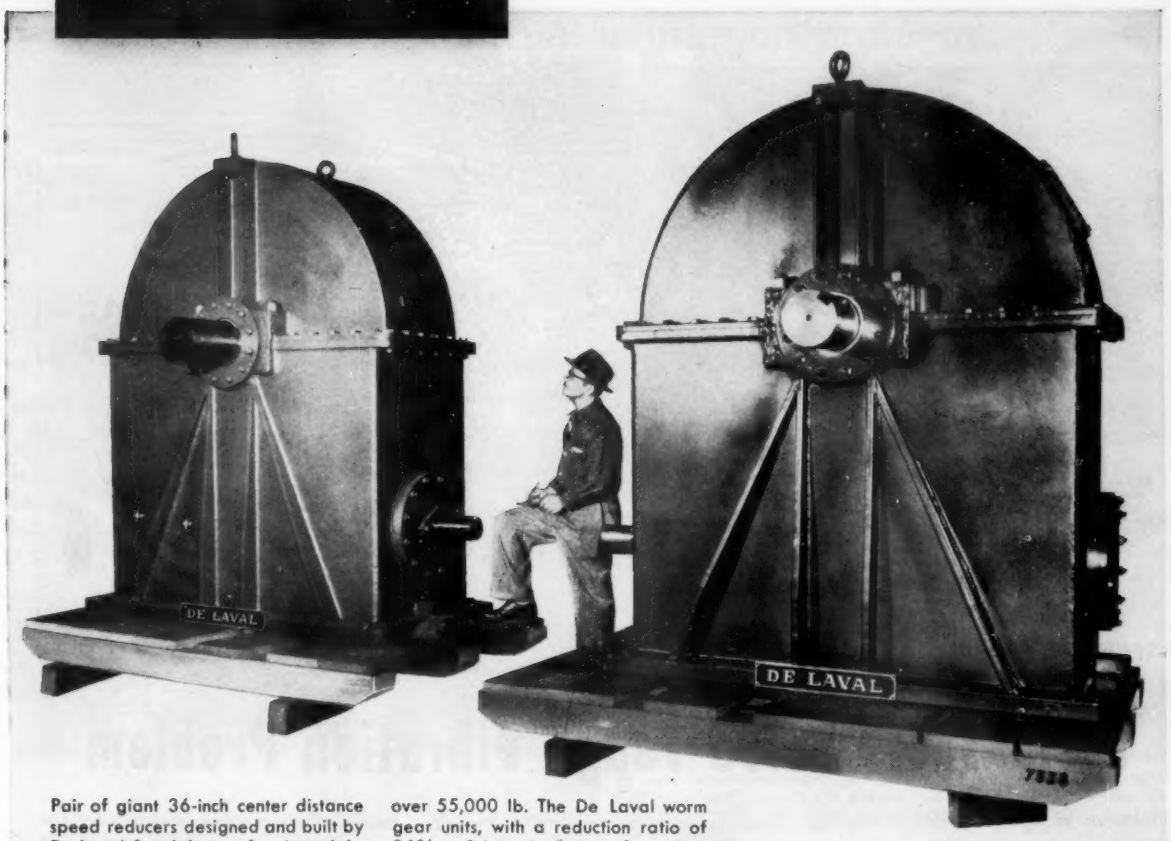
• ALTHOUGH ATOMIC POWER will take years to become a "major competitor" in the power generation field, the nation has no choice but to push its commercial development, according to Westinghouse Electric Corp. A Westinghouse spokesman predicted that the power potential 10 years hence will break down as follows: 132-million kw in steam, 32-million kw in water, 4-million kw in internal combustion engines and perhaps 2-million kw in atomic power.

• AEC HAS AWARDED 42 unclassified physical research contracts to universities, private research institutions and industrial laboratories. These contracts, usually covering a period of one year, are part of AEC's continuing policy of utilizing private research laboratories in conducting atomic energy research.

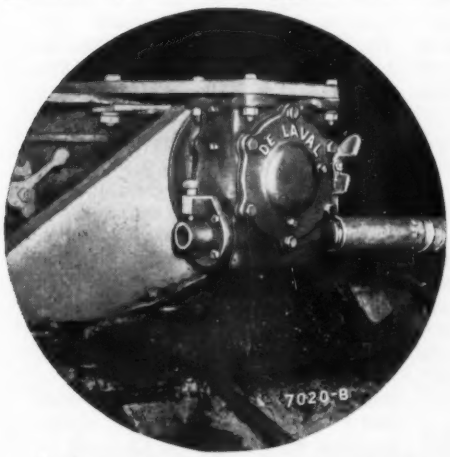
• AEC HAS APPROVED an agreement with Tennessee Valley Authority whereby TVA will make a study, similar to those under way by private industry, of various economic and technical aspects of nuclear power production. TVA will carry all costs of the one-year study and will submit reports and recommendations to AEC. The Commission will determine title to inventions and discoveries and disposition of reports made in the course of the study.

# DE LAVAL
## SPEED REDUCERS

*from dwarf to giant size*




Pair of giant 36-inch center distance speed reducers designed and built by De Laval for slab transfers in a slabbing-blooming mill. These slab transfers are used to convey steel slabs up to 12 in. thick and 42 in. wide, weighing over 55,000 lb. The De Laval worm gear units, with a reduction ratio of 26⅔ to 1 in a single set of gearing, are each driven by a 200 hp, 410 rpm motor coupled directly to the input shafts of the slab transfers.




Here's one of the smaller De Laval worm gear speed reducers with a 3″ center distance being used for a new coal drilling machine.

De Laval heavy-duty worm gear speed reducers seldom require attention under the most rugged operating conditions. They make a quiet, close-couple compact drive. They permit high ratio reductions in a minimum of space and withstand severe shock loads without damage. De Laval builds all sizes from 3″ to 36″ center distances for transmission ratios of 3.1:1 to 100:1 in single reduction units and ratios of 50:1 to 8000:1 in double reduction units. Whether you need dwarf or giant worm gearing, consult De Laval for engineering assistance. *Send for De Laval Manuals G-WBV and G-WWH containing data on single and double reduction units.*

**DE LAVAL** *Speed Reducers*

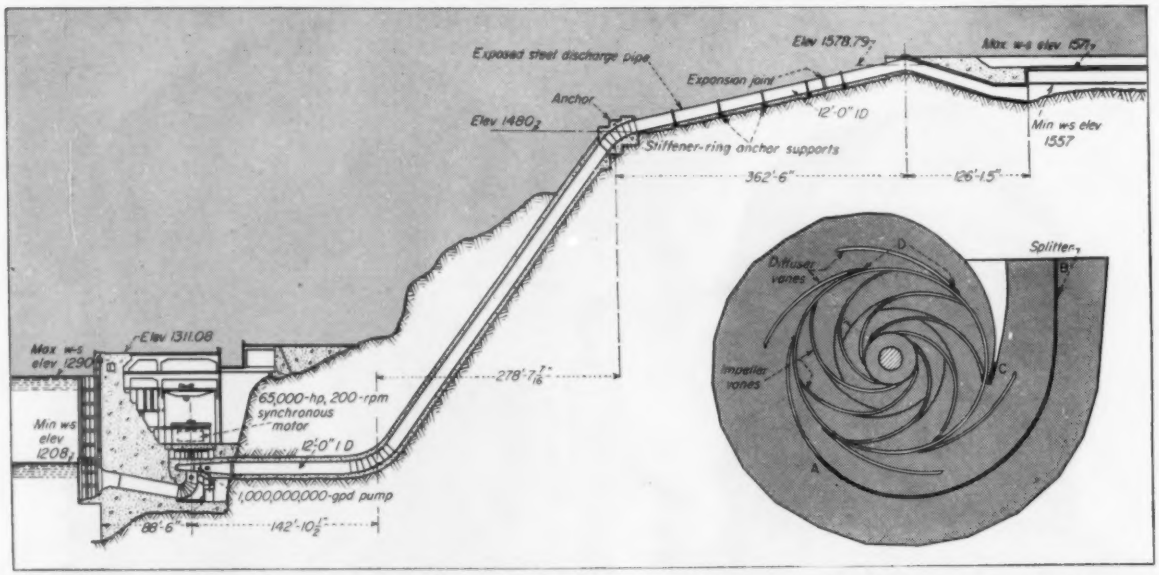
DE LAVAL STEAM TURBINE COMPANY

*815 Nottingham Way, Trenton 2, New Jersey* DL-210

# TECHNICAL BRIEFS

***Latest engineering developments for busy power men***

**10 Digests for you on:**
**TURBINES**
**NOISE CONTROL**
**WATER TREATMENT**
**MISCELLANEOUS**




**GRAND COULEE PLANT:** X-section shows general layout. Splitter and vanes, shown at lower right, were source of vibrations

# Field Tests Solve Tough Vibration Problem

**Vibration of Grand Coulee Pump-Discharge Lines.** *By John Parmakian, engineer, design and construction, U.S. Bureau of Reclamation.*

Grand Coulee pumping plant has its intake in reservoir formed by Grand Coulee Dam on Columbia River in Washington. It is designed for twelve pumps, six of which are now installed. Each is driven by a 65,000-hp 200-rpm synchronous motor and has a capacity of about a billion gpd against a head of from 270 to 365 ft. These pumps discharge water from Grand Coulee reservoir into a secondary reservoir formed by dams in Grand Coulee. From here water flows by gravity for irrigation.

Above drawing shows general arrangement of pumping plant and its 12-ft discharge lines that are from 700 to 940 ft long. For a large part of their length these lines are sealed with concrete in tunnels in the rock, but for a distance of about 360 ft at their top ends they are exposed. The first unit was started May 1951, when intake-water surface was at its highest elevation, 1290 ft.

During initial operation, exposed sections of discharge line vibrated severely. At some locations pipe-shell vibrations were about ½ in. Records of these and of water pressure pulsations in discharge line showed they had a basic frequency of 23½ cycles per sec, vibrations traced directly to the seven impeller vanes operating at 200 rpm. Frequency at which vanes passed fixed point in pump casing was 200 x 7 ÷ 60 or 23½ times per second. To reduce discharge line vibrations to safe limits, magnitude of pump's pressure pulsations were reduced and exposed sections of the discharge line were stiffened.

Since a satisfactory explanation for pressure pulsations was not available, changes in pumps to reduce them were determined from a field test program. Results of this program led to removal of splitter from pump casing. Also about 12 in. was cut off inner edges of five diffuser vanes, as at *D* above, and 20 in. from tongue of pump, shown black at *C*. From discharge end of each of the seven impeller vanes about ¾ in. was removed radially. In addition to reducing pressure pulsations satisfactorily, these changes increased pumps' discharge and efficiency for the low pumping head at which most of this pumping is done.

Pressure pulsations in pumps could not be reduced to point where they did not cause objectionable pipe-shell vibrations, so exposed sections of discharge lines were stiffened by circular ribs. These were fabricated from 8-in. H-bearing-pile sections and were first bolted to pipe shell between existing stiffener-ring anchor supports spaced about 55 ft apart. Minimum practical spacing of added ribs is about 12 ft. These ribs were later welded to pipe lines.

During first two years of operation two pumps delivered over 1,000,000 acre-feet of water and one discharge line stood nearly ½-billion pressure-pulsations without signs of distress in pipe shell. *ASME paper, No. 53-A-50.*

**Kaplan Turbine—Discussion of Design and Trends.** *By J Fisch, chief design engineer, S Morgan Smith Co.*

The adjustable-blade propeller turbine, known in hydro-power industry as a Kaplan type, for its inventor Dr V

## *Meet the man* you can call with confidence to solve your thermal insulation problems

**To insulate outdoor tanks** with complete weather protection, these skilled J-M applicators follow a specification developed by Johns-Manville. Here they are fastening J-M Asbestocite® Sheets over J-M Zerolite® Insulation. J-M 85% Magnesia Insulation is also widely used for this type of equipment

## *He is your J-M Insulation Contractor*... the man with the world's most complete insulation engineering service

"Insulation is no better than the man who applies it." Today, with rising fuel and maintenance costs, it is especially important to place your insulation job in skilled hands. The scientific application of J-M quality insulations by J-M Insulation Contractors will assure you of the maximum return on your insulation investment for years to come. Moreover, you get undivided responsibility for *all* your insulation requirements.

**1. You get dependable materials**—Johns-Manville manufactures a complete line of insulations for every service temperature from minus 400F to plus 3000F. From them your J-M Insulation Contractor can select the right insulation for the most dependable service on your job. To develop new and improved insulation materials Johns-Manville maintains the J-M Research Center—largest laboratory of its kind in the world.

**2. You get dependable engineering**—For 95 years Johns-Manville has been accumulating insulation engineering experience. J-M Insulation Engineers are called upon to solve insulation problems of every type and magnitude, in every industry. Since your J-M Insulation Contractor works closely with J-M Insulation Engineers, he brings to *every* job a high degree of training, skill and experience.

**3. You get dependable application**—Johns-Manville has set up a nationwide organization of J-M Insulation Contractors to serve you. These Contractors maintain staffs of insulation engineers as well as skilled mechanics thoroughly trained in J-M's proved application methods. You can have absolute confidence in their ability to apply J-M insulations correctly for trouble-free performance.

For further information and the name of your J-M Insulation Contractor, write Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay St., Toronto 1, Ont.

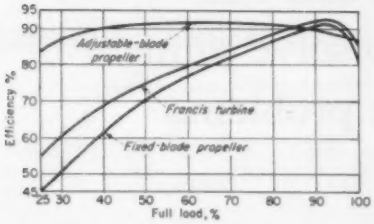
*Reg. U. S. Pat. Off.

# Johns-Manville *FIRST IN* INSULATION

**MATERIALS • ENGINEERING • APPLICATION**

# More TECHNICAL BRIEFS

Begins on page 156




**FLAT CURVE** of Kaplan turbine shows how unit outperforms other design types

Kaplan of Brunn, Czechoslovakia, was first built in Europe in early 1920's and in the United States in 1928. Since then about 274 units with a total capacity of 7,647,000 hp have been installed or are under construction in this country.

Runner diameters in U.S. range from 30 to 292 in. and max operating heads run from 7 to 105 ft. World's highest powered Kaplan turbines are in operation at the U.S. Corps of Engineers' McNary Dam plant and are developing a guaranteed output of 111,300 hp under 80 ft net head. This rating will be surpassed by units being built for Corps of Engineers' Dalles plant. These will be rated 123,000 hp under 81 ft head.

A main feature of Kaplan turbine is simultaneous adjustment of runner blades and wicket gates. When these operations are properly synchronized with load changes, a flat efficiency curve and improved plant-load performance is obtained over other reaction-type turbines, as shown in graph. Usually normal rating, corresponding with generator capacity, occurs at a blade position less than max open and at a point where efficiency is still high. Being able to operate with blades wide open during high-trailwater periods, gives large output during flood seasons when water is plentiful, but capacity is limited as a result of reduced head.

High specific speed of Kaplan runners reduces overall power installation costs because of higher speed generators. This, with turbine's adjustable features, readily justifies its selection for heads up to 100 ft. Flexibility, greater overall power output and conservation of stored water at part load have encouraged wide application of Kaplan turbines for low- and medium-heads. High unit capacity per inch of runner dia results in substantial reduction in dimensions and cost of powerhouse structure and excavation.

Studies of overall power output of multi-unit installations based on head- and flow-duration data usually show worthwhile gains if all Kaplan turbines are used rather than a combination of them with fixed-blade propeller units. Cost comparisons must be based on entire development rather than on turbines alone. Only a relatively small annual kwhr gain is necessary to cover increased cost of Kaplan units. Load division on units is also simplified on an all-Kaplan-turbine installation.

Trend today in Kaplan-turbine installations is toward higher heads into that region where, in the past, frances turbines were only practical choice. Also, development of Kaplan runners for lower-head installations than was formerly economical continues. This has been aided by improved methods of earth and rock removal for large excavations required for lower settings, relative to tailwater elevation.

After reviewing economic features of Kaplan turbine this paper presents a detailed description of design and operation of each of its parts. *ASME paper No. 53-A-101.*

## Noise Control

**Silencers for Compressors.** *By R B Bourne, vice president, Maxim Silencer Co.*

Most compressors, by doing work on gas, generate vibration at intake and in the exhaust. This vibration may be evident as a troublesome audible sound either near the compressor or at a distance. The fundamental frequency of gas vibration may be so low that most of the energy shows up as inaudible pulsations usually accompanied by a series of audible overtones. Acoustic energy in the fundamental frequency can at times tear piping loose from its supports, crack masonry walls and cause other damage.

For example, heavy air-borne pulsations from a large reciprocating scavenging pump on a diesel engine produced vibrations that broke plate-glass store windows about one mile away. Lesser evils include rattling of dishes, shaking loosely hung windows, etc. Again, on pipeline compressors audible noise may not exist, but pulsations within the piping may cause it to fail, or overload the compressor by supercharging through resonance.

High-speed centrifugal blowers and compressors ordinarily do not cause heavy low-frequency pulsations but do produce a loud whine or squeal that is penetrating or even deafening. Often this squeal will come through the casing wall of blower and associated piping to cause high noise levels injurious to personnel. Positive-pressure blowers and vacuum pumps produce a series of frequencies which are ordinarily related. The relative intensities of these frequencies depend on piping layout. With reciprocating air compressors, it is highly desirable to avoid resonance conditions in intake line to prevent supercharging compressor.

Satisfactory silencers are available for any type compressor, but type used depends on compressor and its piping layout. Too often silencer problem is thought about at the last moment when too little space is left to install a proper unit.

Silencer manufacturers know from long experience the proper type to supply. In general, silencers should be installed as close to compressor as possible to avoid resonance at low frequencies and to prevent noise from piping. A silencer will not be a failure if installed in an unfavorable location, but when properly installed it works a lot better and everyone will be happier. *ASME paper No. 53-A-54.*

**Noise Control in Industrial Areas—Principles and Practices.** *By William A Jack, Johns Manville Research Center.*

Noise control problems can be handled in several ways, but the one favored by an individual depends on his interest in noise reduction or elimination. The acoustical engineer often must control noise from a large machine without affecting its output, interfering with its operation, taking much space or spending much money. The results of his efforts range from brilliant success to complete failure.

What can be done to control noise

(*Continued on page* 220)

### TO OBTAIN COMPLETE TEXT

*Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from sources, not* POWER.

*American Society of Mechanical Engineers, annual meeting, Nov 29-Dec 24, Hotel Statler, New York, N. Y. Identified by initials ASME and obtainable through ASME, 29 W 39th St, New York 18, N. Y.*

*Engineering Society of Western Pennsylvania. Identified by initials ESWP and available from ESWP William Penn Hotel, Pittsburgh, Pa.*

# Whatever your fuel needs, we have a coal that is

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● In fact, you can write *your own* ticket—for the vast Bituminous fields served by the Baltimore & Ohio contain excellent coals *in wide variety*. For centuries to come, these coals will be available—a dependable source of low-cost heat and energy.

Modern mechanization at the mines assures low costs as well as uniform size and quality. The location of the fields—close to industry's front door—contributes to low transportation expense. Storage is economical because costly facilities are not required. And with the help of new combustion methods and equipment, Bituminous offers its users an increased burning potential.

*ASK OUR MAN!* He can give you worthwhile advice as to supply sources and burning methods for the particular coal you need. The efficiency, economy, and cleanliness of B&O Bituminous today will be a revelation!

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LINKING 13 GREAT STATES WITH THE NATION

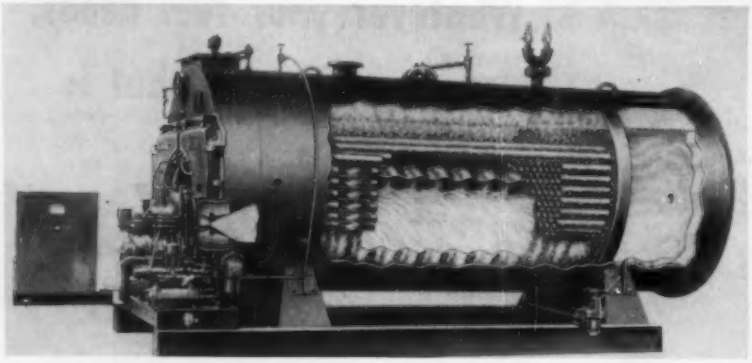
# BALTIMORE & OHIO RAILROAD

**Constantly *doing things*—better!**

# PLANT EQUIPMENT NEWS

***Your information center for new products designed to solve plant problems***

Published monthly as a service to readers



## New Boiler-Burner Unit Features Wide Flexibility

**201** • Boiler-burner combinations satisfy need for fully integrated, skilfully engineered uits. Equipment includes both steam and water models ranging from 39 to 456 hp for high pressure steam and from 1,313,000 to 15,300,000 Btu for 15 lb steam or 30 lb water.

All models are capable of firing No. 6 or lighter oil, low pressure gas or a combination of the two. Skid-mounted boilers are Scotch type, pre-tested and equipped with all necessary accessories. Burners include forced-draft air supply and all combustion controls mounted and pre-wired in one central control cabinet.

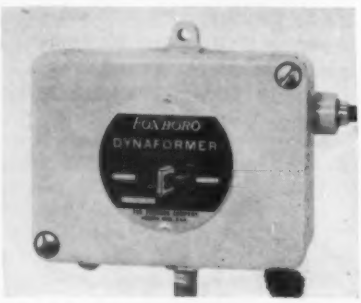
Matching connections permit quick, easy attachment of boiler and burner. Refractories are integrally mounted at factory. Forced draft operation eliminates need for high stack. Boilers conform to ASME construction code and are rated in accordance with established code of Steel Boiler Institute. Burners are UL-approved. Illustrated catalog available from manufacturer.

**Kewanee-Ross Corp, Kewanee, Illinois**

## Tube Gage

**206** • Unusually versatile gage for plus, minus and differential readings serves as air filter gage, static pressure indicator, draft gage, air speed meter, etc. Ranges are 0-3 in. and 0-7 in. water with low range accuracy of .01-in. water. Full details available from manufacturer.

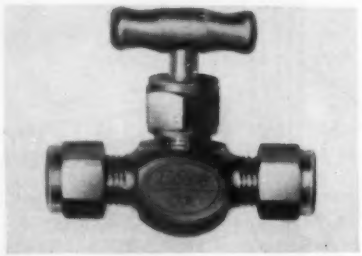
**F W Dwyer Mfg Co, 317 S Western Ave, Chicago 12, Illinois**




## Pressure Cell

**225** • New transducer, *Dynaformer* pressure cell, is highly sensitive element for converting fluid pressure into proportional ac voltage. Cell is accurate to within ±¼% at any point and is protected against overrange to 150% of its rating. All parts are enclosed in splashproof, rubber-gasketed, cast aluminum case with pressure-tight cable connection. Complete data, including circuit details, and cell specs available in Tech Report *TI 27-A-12a*.

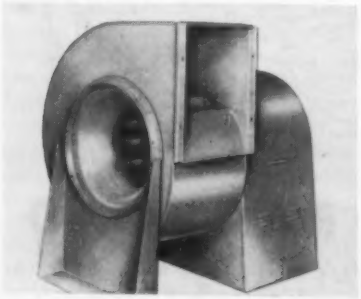
**Foxboro Co, Fosboro, Mass.**



## Air Valves

**230** • New line of small instrument air valves features *Swagelok* ends that provide leakproof and torque-free seals on every type of instrumentation installation. Arrow embossed on body shows direction of flow. Valves are available in brass, aluminum, steel and stainless steel. Further information available from manufacturer.

**Crawford Fitting Co, Cleveland 10, Ohio**



## Ventilating Sets

**227** • New line of all-purpose ventilating sets contains fan, motor and drive in single package. In two series, line covers combined capacity range of 200 to 14,400 cfm. For outdoor mounting, weatherproof covers are available. Further details available from manufacturer.

**Westinghouse Electric Corp, Box 2099 Pittsburgh 30, Pennsylvania**

## Radiographic Instruments

**256** • Two new instruments applying principles of radiography are available for measuring applications. The first, a panel mounted unit, determines sp gr or density of materials in a vessel by measuring absorption of gamma rays from radium salt passing through the material. The second measures pipe thicknesses from 2 to 12 in. An experienced operator can detect thin wall sections as well as buildup inside the pipe, according to the manufacturer.

**Instruments, Inc, 122 N Madison, Tulsa, Oklahoma**

For more data on these items, use post cards p 169. Identify your request with item number.

# SAFE CONTROL

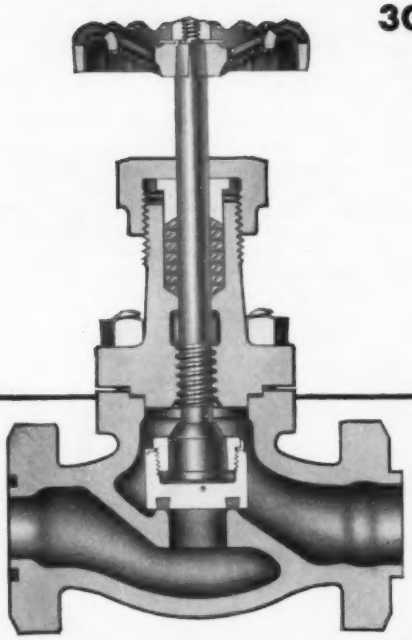
**for ammonia and other hard-to-handle fluids**

# CRANE

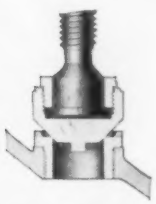
## 300-pound heavy-duty all-iron valves

Put these Crane valves to the test—use them for ammonia, air, oil, gas, caustic solutions, chlorinated compounds, alcohols —for chemicals and process work. Their rugged bodies of Ferrosteel (35% stronger than cast iron) . . . their precision seating designs . . . the unusually deep stuffing box and high-grade packing . . . the sweeping interior body contours . . . assure the safety and lasting service you want.

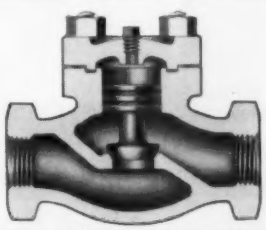
The line includes *bolted bonnet* globes and angles with choice of disc, *union bonnet* globes and angles with plug-type disc, lift checks, expansion valves, relief valves, liquid gauges —and all the fittings, flanges, return bends and other specialties for a complete Crane Quality installation. Check with your Crane man.



Cross-section bolted bonnet Globe, with flanged ends and special lead-faced disc. Sizes ¼ to 4-inch.



Bolted bonnet Globes also available with steel disc and seat where high temperatures or corrosion prohibit use of lead.



Cross-section, Lift Check with bolted cap, and cushioned disc action which increases valve life. Sizes ½ to 2-inch.

New 6-page folder AD1977 catalogs this complete Crane line. Write direct, or ask your Crane Representative.

*THE BETTER QUALITY . . . BIGGER VALUE LINE . . . IN BRASS, STEEL, IRON*

# CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
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***VALVES • FITTINGS • PIPE • PLUMBING • HEATING***

# More EQUIPMENT NEWS

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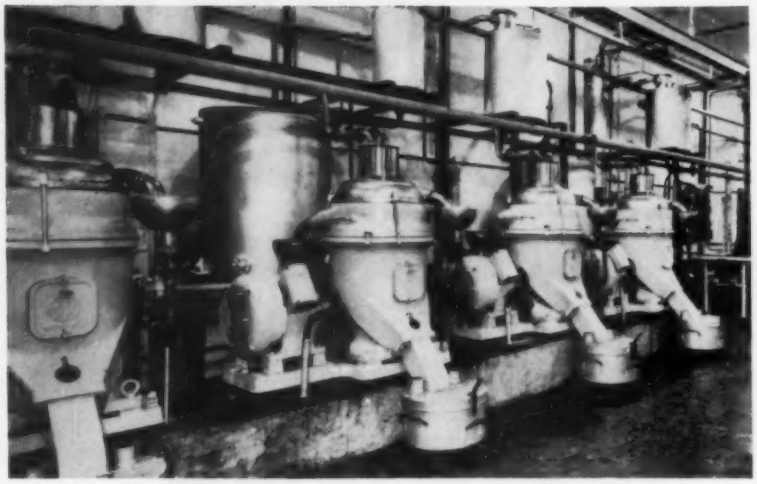


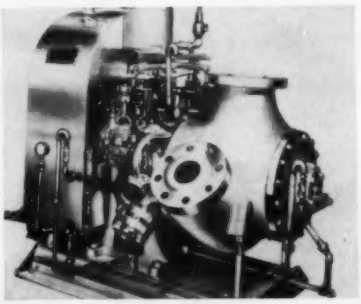
### Self-cleaning Precipitators Now Available in U. S.

**203** • Titan self-cleaning centrifugal separators, used for last 25 years throughout the world, are for the first time available in U. S. These Danish centrifuges are distinguished by their exclusive ability to discharge sludge of any viscosity from the separating bowl either automatically or manually while running at full speed.

Because of this self-cleaning feature, operating speed is continuous and there are no losses as a result of downtime during manual bowl cleaning. Manufacturer claims construction of Titan centrifuge is fool-proof and maintenance costs are far below those of conventional units.

Further information concerning these recently introduced separators may be obtained by contacting Titan's newly appointed North American sales and service representative.

**Pitmar Centrifugal Machine Corp, 10 E Fayette St, Baltimore, Maryland**



### Turbo Pump

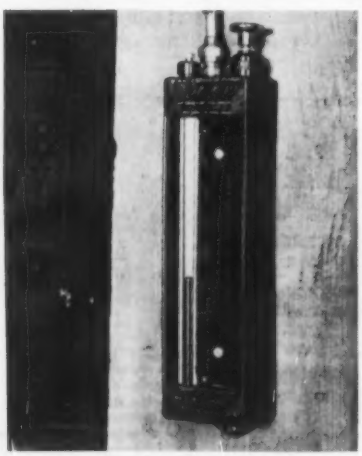
**214** • Engineered to keep pace with increasing steam pressures, new *Type DE* is a highly efficient, single-stage, high-speed, steam turbine-driven centrifugal pump. Unit is designed for compact external piping that permits simple and inexpensive installation. Pump and turbine rotor are mounted on a common alloy-steel shaft. Pump covers volumetric range to 800 gpm, discharge pressures to 1000 psig, temperatures to 325 F. Further details available.

**J S Coffin, Jr Co, 326 S Dean St, Englewood, New Jersey**

### Controlled Volume Pumps

**257** • New Controlled volume pumps, designed especially for handling dangerous fluids, have entire liquid end assembly submerged in a sump with only driver and discharge piping exposed. This eliminates problem of stuffing box leakage. Capacities range up to 3200 ml per hr, pressures up to 1000 psi. Further details are available on request to manufacturer.

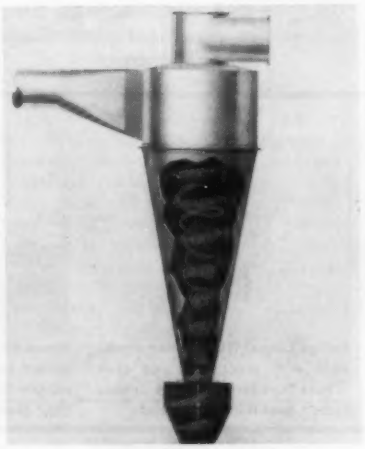
**Milton Roy Co, Station F, Philadelphia, Pennsylvania**



### Remote-Reading Gage

**233** • New remote-reading tank gage for use with vented fuel oil, gasoline and diesel oil tanks to 9-ft depth can be located wherever most convenient. Unit has four different scales to cover wide range of API gravities. Gage works as a frictionless hydrostatic balance and has no moving parts except small air pump built into case. Full details available in manufacturer's illustrated bulletin 375.

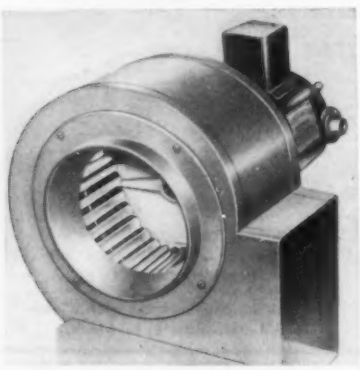
**King Engineering Corp, Box 310, Ann Arbor, Michigan**



### Dust Collector

**212** • New mechanical dust collector separates dust from air by centrifugal force. Units are available in standard sizes from 18 to 84-in. dia body and in single, duplex, quadruplicate and 2-stage arrangements. They operate under either suction or pressure to collect all manner of dry industrial dusts when gas temperature is under 800 F. Further details are available on request to manufacturer.

**A W Banister Co, Inc, 23 Charles St, Cambridge, Massachusetts**



### High-Volume Blower

**208** • Large capacity blower (6-in. wheel) moves up to 600 cu ft of air per min and features automatic cutout that stops completely enclosed motor before it can overheat. Additional information available from manufacturer.

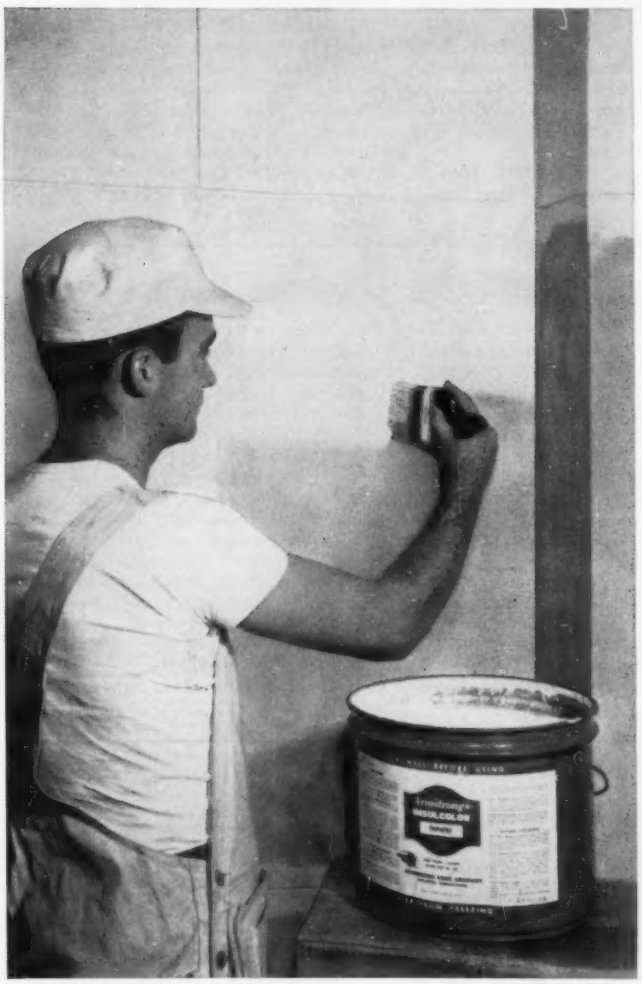
**Standard Electric Mfg Co, Inc, West Berlin 12, New Jersey**

For more data on these items, use post cards p 169. Identify your request with item number.

INTRODUCING

# Armstrong's Insulcolor

## A washable, plastic, cold-room finish that won't crack, shrink, or craze



Now you can have bright, sanitary cold-room interiors that are easy to clean—that stay fresh and attractive year after year! Armstrong's Insulcolor —available in white and seven colors—is a newly developed plastic coating for use in low-temperature rooms. Completely washable, it bonds firmly to portland cement plaster, asphalt emulsion, and bare corkboard surfaces. Low temperatures have no harmful effects on Insulcolor. This finish will hold up as long as the base to which it's applied.

**SAFE TO USE.** There are no inflammable solvents in Insulcolor, so fire hazard is eliminated during application. Wet or dry, Insulcolor is completely fire-resistant.

**EASY TO CLEAN.** Dust, dirt, grease, and soot can be readily washed off Insulcolor's smooth surface. A single Insulcolor application lasts many years without recoating.

**USE INDOORS OR OUTDOORS.** Highly resistant to water and surface damage, Insulcolor can be used over outdoor piping and equipment, as well as in indoor applications.

**FOR FREE BOOKLET**—describing the use and application of Insulcolor—call your nearest Armstrong office or write to Armstrong Cork Company, 2502 Riggs Avenue, Lancaster, Pennsylvania.

**Easy to Apply.** Insulcolor is quickly applied to insulation with either brush or spray gun. On most materials, two coats form a strong, protective film.

**INSULCOLOR IS AVAILABLE IN THESE COLORS:**
white - dark and light blue - dark and light green - buff - yellow - gray

**NEW INSULCOLOR PROTECTS AND IDENTIFIES INSULATED COLD AND HOT LINES, DUCTS, TANKS**

Identification of brine, cold-water, steam, and other lines has usually been by stenciled words or painted colors, applied after the finish was dry. Now, with Armstrong's Insulcolor, you get color identification and insulation finish in one application.

ARMSTRONG'S INSULCOLOR

# More EQUIPMENT NEWS

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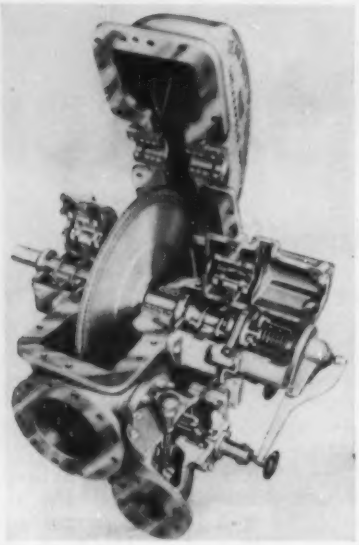


## Improved Turbines

**204** • Entire line of horizontal turbines are featuring major improvements including: addition of steam nozzle to all models, water-cooled bearings and four carbon rings in *DH-10*, three steam nozzles in *DH-30*, *DH-40* and *DH-45*.

Redesigned governor valve and trip valve eliminate use of packing on valve stems for high pressure and high temperature turbines. Addition of hand valve increases part load performance. Larger and improved carbon ring packing glands increase max backpressure from 50 to 75 lb.

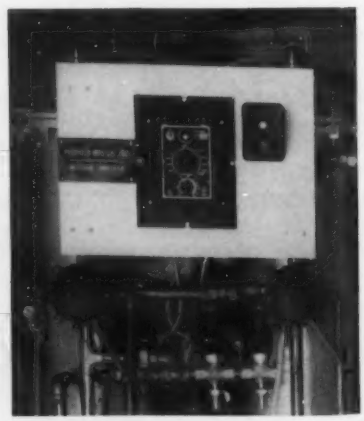
Specific designing for applicable speed, hp, pressure and temperature eliminates costly extra weight resulting from special materials and controlling devices necessary for only unusual conditions. Most turbine parts are interchangeable with other models in the line. Further information available from manufacturer.

**Dean Hill Pump Co, 4400 E 16th St, Indianapolis 7, Indiana**

## Rotary Joint

**213** • New type packless and leakproof rotary joint operates on ball-and-socket principle and is available in two types: *Thru-Flo* type has single inlet unit designed to transfer fluids into or out of any revolving drum; *Syphon* type, shown above, designed for installations where inlet and outlet is desired in same unit or for siphon drainage of condensate from the steam chamber of roll or drum. Units are adaptable to both high and low pressure installations. Further details from manufacturer.

**Key Co, 27th and McCasland Ave, E St Louis, Illinois**



## Demineralizer

**218** • New demineralizer has special controls that permit automatic maintenance of storage tank water supplies at definite, known purity standards. After regeneration cycle, operator switches on unit's automatic controls to perform all functions including signalling when another cycle is needed. All operations, except regeneration, are completely automatic and require no attendant.

Regeneration follows customary "ion-exchange-in-reverse" process of "washing" cation resins with acid solution and anion resins with caustic to return them to original active state. Further information available from manufacturer.

**Penfield Manufacturing Co, Inc, 19 High School Ave, Meriden, Conn.**

## Control Valves

**258** • New interior construction greatly simplifies control valves and assures positive positioning of sealing packers without placing any mechanical pressure on packers themselves. Principal parts consist of housing with straight-through bore, gland nuts for ends, hollow, radially-ported ground and polished stainless steel plunger, internal spacers held firmly in metal-to-metal end abutment and two sizes of "O" rings.

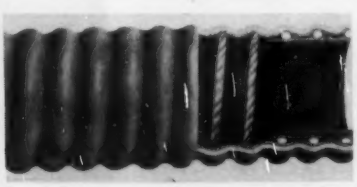
Valves are available in push-pull, push spring return, hand, foot, cam, diaphragm, pilot, and single or double-solenoid operated with 2 to 5-way actions and either open or closed exhausts. They are furnished tapped for either ⅛ or ¼-in. connections. Full details from manufacturer.

**C B Hunt & Sons, Inc, Salem, Ohio**

## Torque Wrench

**259** • Torque wrench with 0 to 1000-ft-lb capacity shows definitely when nuts and bolts are just tight enough. Dial accurately registers torque reading and remains at maximum after tension is released. Simple turn of center knob resets dial. New wrench assures the uniform tension that prevents equipment failures resulting from torquing of nuts and bolts.

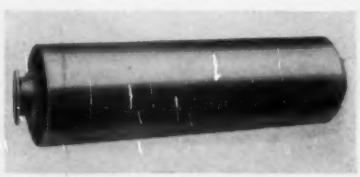
**Frontier Industries, Inc, Manzel-Division, 244 Babcock St, Buffalo 10, N. Y.**



## Suction Hose

**217** • High-grade suction hose with red covers is reinforced with specially treated hard twisted cord instead of the usual wire. This construction offers advantage of complete recovery after crushing. Sizes range from 1 to 3 in. ID with weights from 75 to 262 lb per 100 ft. Hose can be made with straight or enlarged ends. Further data from manufacturer.

**Hamilton Rubber Manufacturing Corp, Trenton 3, New Jersey**

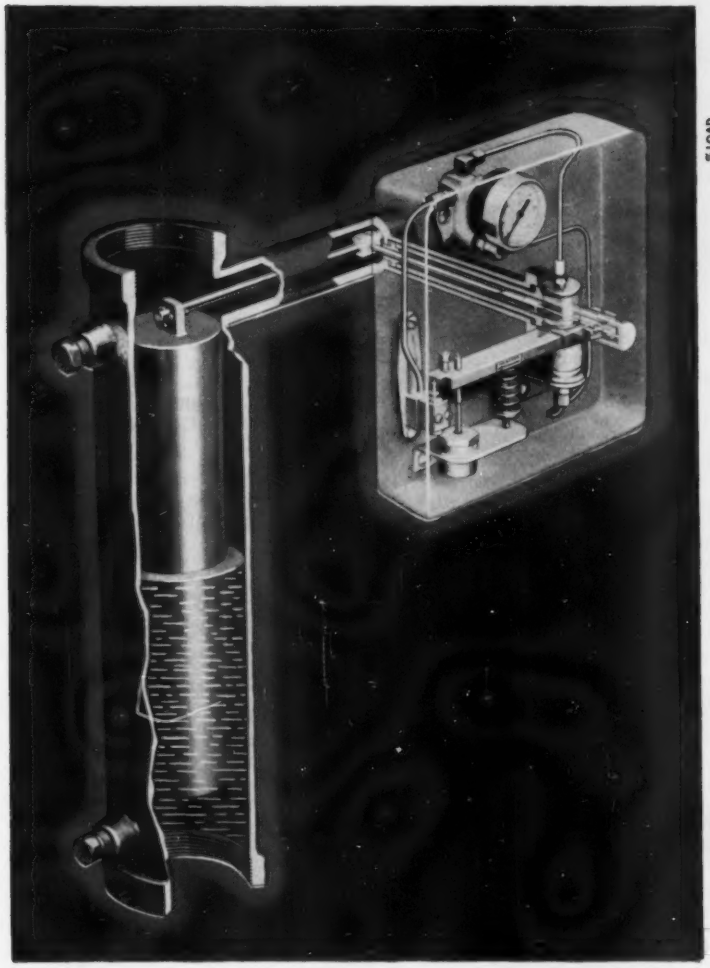


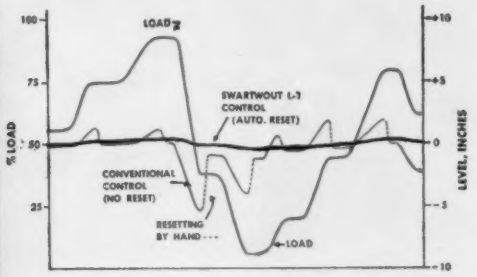
## Intake-Exhaust Silencers

**260** • New series of silencers cut noise of air compressors, blowers, vacuum pumps and other machines expelling high-velocity air. Known as *Series CA* and *LCA*, units operate under moisture-free air conditions at temperatures up to 200 F. Both series are absorption-type silencers employing straight-through acoustically transparent perforated tubes surrounded by a deep layer of highly efficient absorbing material.

**Burgess-Manning Co, Libertyville, Mo.**

# Hold liquid levels within ±1/2 inch automatically with Swartwout L1 Displacement Type Controls



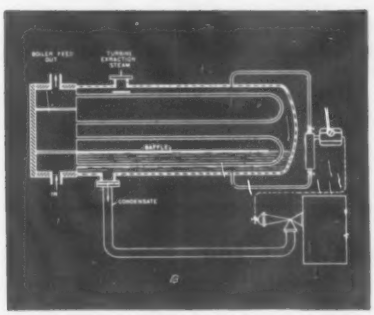



**1** Precise control of liquid level from no load to full load without manual readjustment is provided by Swartwout L1 Controls. Setback and reset features compensate for quick-changing loads or long process lags . . . eliminate any tendency to cycle or hunt, yet permit control within narrow range of ±½ inch. Graph *(above)* shows precision of L1 compared with conventional control on applications where level must be maintained within ±½ inch.

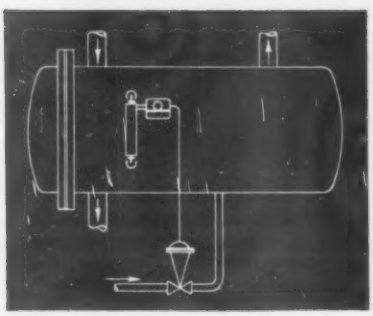
Operating on balance of forces principle, there is little actual movement of parts. Torque tube design eliminates stuffing boxes . . . gives continuous leakproof operation. Since changes in liquid level vary effective weight of displacement type float, L1 Controls can also be used for throttling over full length of float, available in lengths from 15 to 120 inches. A-3696

**Swartwout**

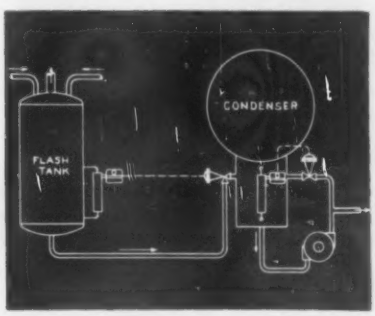
POWER PLANT EQUIPMENT
PROCESS INDUSTRY CONTROLS
INDUSTRIAL VENTILATION



**2** Horizontal Subcooled Heaters—L1 Control holds level to ±½ inch, never lets condensate cover tubes that should be exposed to steam . . . never exposes tubes that should be covered with condensate.



**3** Evaporators—Swartwout L1 Displacement Type Control holds level within ±½ inch . . . prevents carryover of solids and contamination of boiler feed water. Increased plant efficiency results.

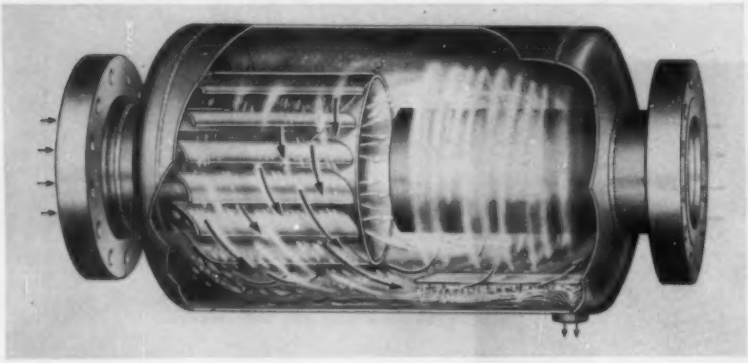



**4** Flash Tanks—Level maintained, in some installations, by L1 Control draining to condenser. Hot well level precisely maintained by controlling condensate recirculation from pump discharge.

SEND FOR BULLETINS S-15-A, S-208-A • THE SWARTWOUT COMPANY, 18511 EUCLID AVENUE, CLEVELAND 12, OHIO

# More EQUIPMENT NEWS

Begins on page 160

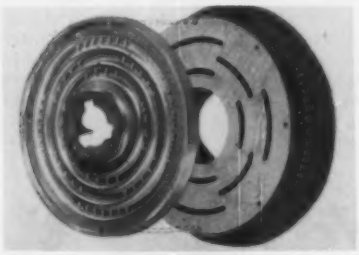


## New Separator Installs in Minimum Space

**202** • New separator, identified as 31-N, is a refinement of the 30-N model now in wide use throughout industry. For use in horizontal steam, air and gas lines, this unit uses the proved centrifugal force principle to remove entrainment such as water, oil and solids from pressure lines and to deliver a clean flow of fluids to receiving equipment.

Like the 30-N, this model installs in minimum space and occupies scarcely more room than pipe section it replaces. The 31-N is self-cleaning and is applicable throughout a wide pressure range. Construction is of fabricated steel. Further details may be obtained by writing to manufacturer directly on company letterhead.

**Wright-Austin Co, 3245 Wight St, Detroit 7, Michigan**



## Floor Scrubbers

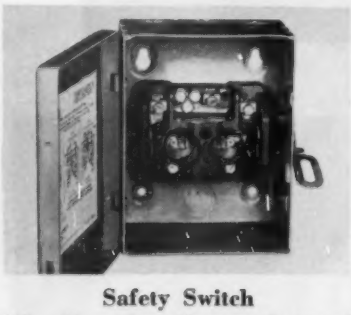
**238** • New refill blocks for floor scrubber permit on-the-job replacement of worn brushes. Blocks are available with a variety of bristles: Palmetto, bassine, steel wire, nylon and combinations. New replacement pieces are suitable for Model "C" and "UC" machines only. Full details are available from manufacturer.

**Hild Floor Machine Co,**
**740 Washington Blvd, Chicago 6, Ill.**

## High Capacity Bearing

**216** • New high-capacity thrust roller bearing supports vertical thrust load of 380,000 lb at 16 rpm and has rated capacity of 700,000 lb. Designated *T-21906*, bearing is 25¾ in. OD, 17 in. ID, 3¾ in. thick. Equipment is recommended for installations where space is limited. It can also be used on horizontal shaft applications to overcome common problem of maintaining sufficient amount of lubricant in bore of roller assembly. Further details available.

**Rollway Bearing Co, Inc, 543 Seymour Syracuse, New York**



## Safety Switch

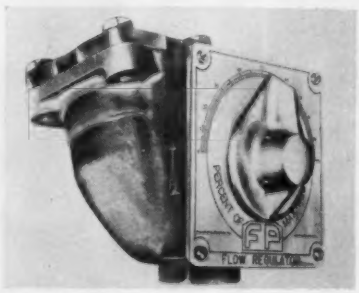
**239** • New 30-a side-operated general-purpose safety switch features strong rotor blade construction that allows for cool operation and double break on each pole. Switches are available in both two and three-wire with plug or cartridge fuse. Special features include generous wiring room, convenient knockouts, solderless connectors on line terminals and baked on *Melamine* finish. Further information and catalog section available from manufacturer.

**Murray Mfg Corp, 1250 Atlantic Ave, Brooklyn 16, New York**

## Conduit Couplings

**234** • New 4 and 5-in. flexible conduit fittings have four bolt clamps and ridges cast into clamping member to engage convolutions of flexible conduit. All units are of heavy duty construction. Full details are available in Bulletin Print No. 154.

**Adalet Mfg Co, 14300 Lorain Ave, Cleveland 11, Ohio**




## Flow Regulator

**222** • New self-operated flow regulator fills need for low-cost dependable control. Unit is compact, simple in design and can be screwed directly into pipeline to maintain preset flow rate despite changes in upstream or downstream pressure. Operating entirely on liquid passing through it, it requires no outside source of energy. Sizes range from ½, 1 to 2 in. for flows of 0.5-5, 1.0-15 and 6-80 gpm. Unit is applicable to such flows as feeds to reactors or spray dryers or stills, reflux and drawoffs, spray and wash water, cooling water for bearings, heat exchangers, etc. Further information available from manufacturer.

**Fischer & Porter Co,**
**17 Jacksonville Rd, Hatboro, Pa.**

For more data on these items, use post cards p 169. Identify your request with item number.

## CHECK THESE TOO . . .


**Speed Control** . . . . . p 174
**Hand Tachometer** . . . . . p 176
**V-12 Engine** . . . . . p 178
**Fuse Cutouts** . . . . . p 180
**Ac Motors** . . . . . p 182
**Sealed Ignitrons** . . . . . p 184
**Insulation Tester** . . . . . p 186
**Pulling Attachment** . . . . . p 188
**Vacuum Machine** . . . . . p 190
**Water Demineralizers** . . . . . p 192

# Keeping Thermal Expansion Under Control

**Flexible support for piping in all positions of travel must be provided, if destructive stresses and strains are to be avoided in today's high temperature piping systems.**

Heat 100 linear feet of alloy steel pipe to 1000° F, and it will expand 9.1 inches! When this thermal expansion takes place in a piping system, the resultant forces induced, if uncontrolled, can do incalculable harm.

### Helical coil springs

The practice of using helical coil springs to allow this thermal expansion to occur is quite general. But the care that goes into the design or selection of flexible supports ofttimes is haphazard. In fact, many specifications covering the support of important high temperature piping will simply say "spring hangers shall be provided". Merely to contend that this may be dangerous is not enough.

### Safety of entire system at stake

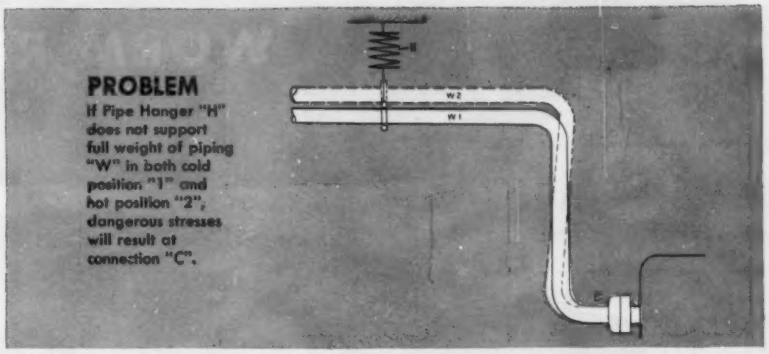
Unless careful study is given to the design and selection of spring supports which will maintain a balanced pipe system, the transfer of weight from one hanger to another, or from a hanger to a terminal point, will endanger the safety factor of the entire system.

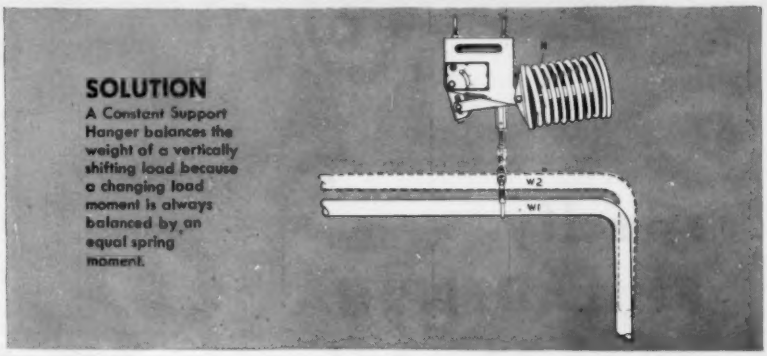
With 8 . . . 9 . . . even 10 inches of thermal deflection not a bit uncommon today, completely flexible support for piping in all positions of travel is a positive "must".

### The case for constant-support hangers

Where reactive forces at terminal points in a piping system must be kept within specified limits, constant support type hangers are recommended.

They are designed to provide uniform supporting force equal to the pipe load throughout the travel range and should be used at superheater outlets, turbine connections, and also on high temperature and other critical lines.

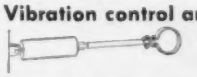

PROBLEM
If Pipe Hanger "H" does not support full weight of piping "W" in both cold position "1" and hot position "2", dangerous stresses will result at connection "C".
W2
W1


SOLUTION
A Constant Support Hanger balances the weight of a vertically shifting load because a changing load moment is always balanced by an equal spring moment.
W2
W1

### Variable spring hangers

When pipe lines are subject to vertical movement, and restrictive conditions do not require a constant-support type hanger, variable spring hangers are recommended. They should be designed to support not less than 85%, or more than 120%, of the design load throughout the total travel.

### Vibration control and sway brace



When necessary to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing or instant-acting counter force type, are recommended. They dampen vibration, oppose pipe sway and absorb shock.

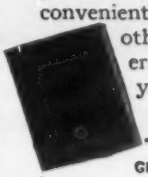
### Hanger Engineering Service

The Pipe Suspension Department of Grinnell Company offers a design service to engineering firms which appreciate the specialized knowledge required to compute hanger loads and to select the proper supports for a balanced pipe suspension system when high pressures and high temperatures are involved.

Grinnell manufactures a complete line of pipe hangers and supports; maintains an experienced laboratory staff of technicians to discover better ways of solving pipe suspension problems; provides engineering assistance in design and installation; offers stocks of pipe hangers close to any job.

### Hanger load calculation booklet

A 28-page booklet entitled "Hanger Load Calculations", compiled to furnish necessary data and procedure to determine pipe hanger loads, can be obtained from Grinnell Company. The tabulations of piping weights and thermal expansion have been arranged for convenient selection of data that otherwise consume considerable time to develop. It's yours without obligation.



GRINNELL COMPANY, INC.

278 West Exchange St., Providence, Rhode Island

Kindly send me a complimentary copy of your "Hanger Load Calculations" booklet.

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Company.....

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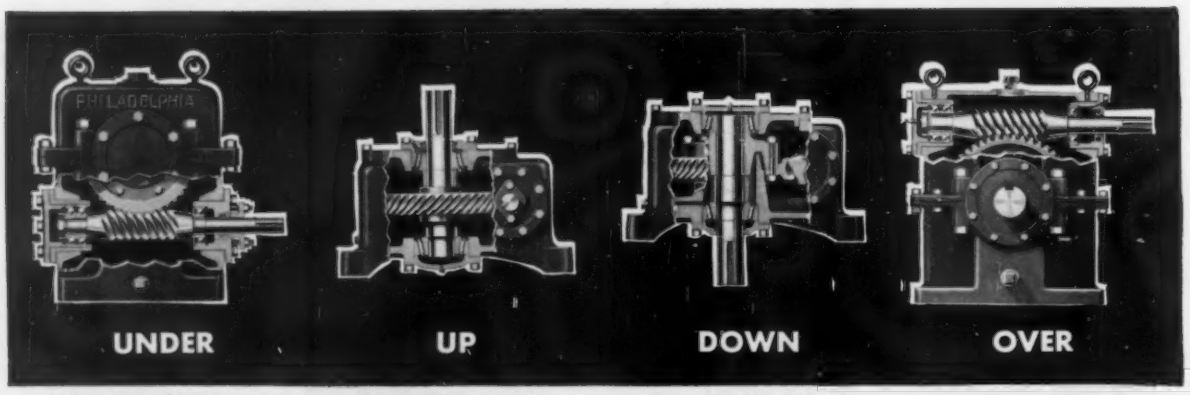


Type "AT" Philadelphia Heavy Duty Worm Gear Reducer, with worm shaft *below* the worm gear.

Type "UT" Heavy Duty, Vertical Worm Gear Reducer, with slow speed shaft extended upward.

Type "VT" Heavy Duty, Vertical Worm Gear Reducer, with slow speed shaft extending downward. (Note "dry-well" construction around downward shaft.)

Type "RT" Philadelphia, Heavy Duty Worm Gear Reducer, with worm shaft above the worm gear

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### AIR CONDITIONING

1 **Electric Heaters** and heating devices. Two-color, 60-page catalog indexed by processes and applications. Photos, drawings, full specs. GEC-1005E, General Electric Co, Schenectady 5, N. Y.

2 **Lightweight,** horizontal-discharge utility unit heaters for general purpose heating. Engrg data, piping and wiring details. L J Wing Mfg Co, Linden, N. J.

3 **Ventilation engineering** information bulletin. 16-page booklet. Photos, tables, graphs, full engrg data. Bulletin A-108, Hartzell Propeller Fan Co, Piqua, Ohio.

4 **Gas-fired unit heaters** in 14 models ranging from 55,000 to 500,000 btu per hr capacity. Two-color, 12-page bulletin. Photos, cutaways, full spec tables. Bulletin 23-3, U. S. Air Conditioning Corp, 33rd and Como Ave, SE, Minneapolis 14, Minn.

### BOILERS & AUXILIARIES

5 **Fixed-position** rotating blowers for cleaning tube banks in boilers, superheaters, heat exchangers, etc. Two-color, 8-page booklet. Photos, cutaways, dimensional drawings, full spec. Bulletin 1137, Diamond Power Specialty Corp, Lancaster, Ohio.

6 **Boiler water** sample cooler. Two-color, 4-page folder. Photos, design spec, flow rate charts. Bulletin 110, Davis Engrg Corp, 1064 E Grand St, Elizabeth 4, N. J.

7 **Packaged dehydration** units for efficient drying of air or other gases in all industrial installations. Two-color, 8-page booklet. Photos, dimensional drawings, full specs. Bulletin 16.0.081, J. F. Pritchard & Co, 210 W 10th St, Kansas City 5, Mo.

8 **High and low-pressure** steel boilers for commercial and industrial use. 32-page general catalog. Photos, full specs. Catalog 30, Kewanee-Ross Corp, Kewanee, Ill.

### CONTROLS

9 **Construction,** operation and application details on pneumatic remote index-setting devices. 4-page folder. Photos, sketches, graphs, tech data. Bulletin 8930, Minneapolis-Honeywell Regulator Co, Wayne and Windrim Ave, Philadelphia 44, Pa.

10 **Electronic controls** for hot water heating systems. Two-color, 8-page booklet. Photos, application diagrams, full specs. Bulletin P6167, Barber-Colman Co, Rockford, Ill.

11 **Robot-Eye combustion** control for rotary cup burners. Two-color, 4-page folder. Photos, dimensional sketches, complete data. Bulletin SA 11-50, Standard Instrument Corp, 350 Fifth Ave, New York 1, N. Y.

### ELECTRICAL EQUIPMENT

12 **Dry batteries** for various industrial uses including public utility service. Illustrated, catalog-style leaflet. General Dry Batteries, Inc, 13000 Athens Ave, Cleveland 7, Ohio.

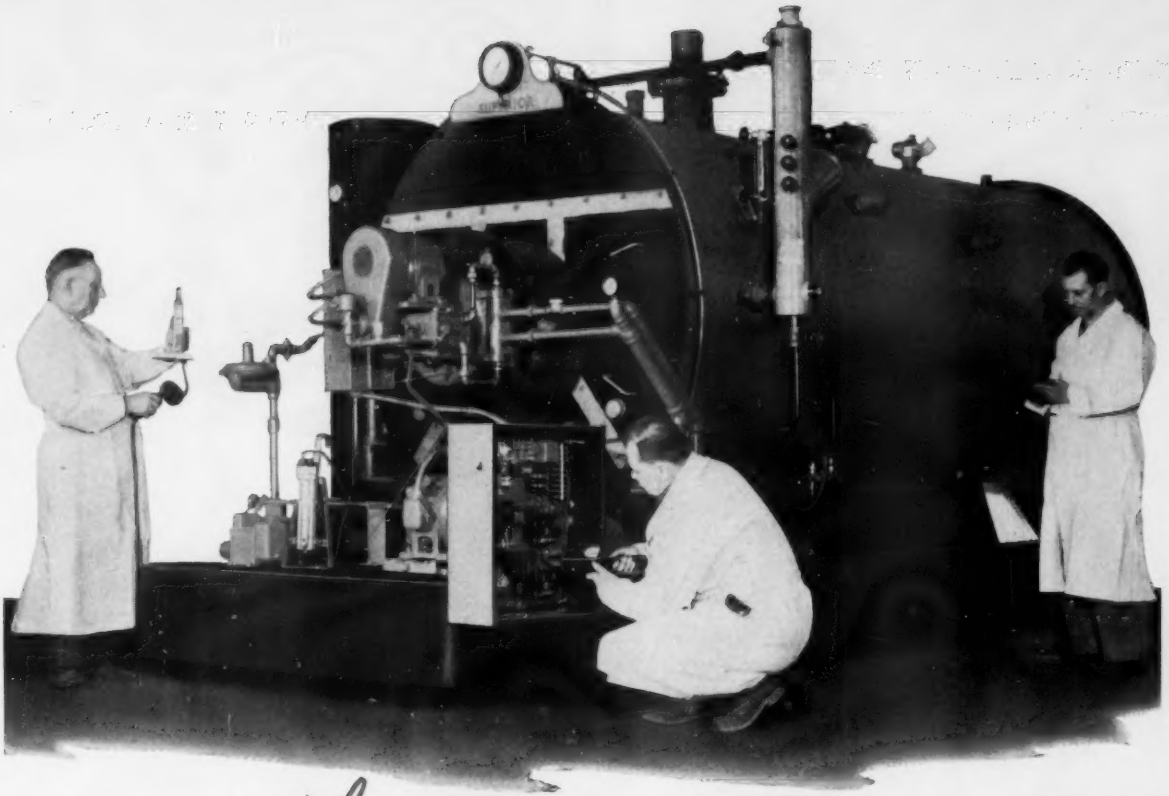
13 **Heavy duty** trolley busway electrical distribution systems. 28-page booklet. Photos, installation plans and procedures, complete data. Bulletin 35, Feedrail Corp, 125 Barclay St, New York 7, N. Y.

14 **Electrical control** equipment, power transmission equipment, and electrical switchgear. Two-color, 16-page brochure. Equipment and installation photos, full details. Catalog Division, Nelson Electric Mfg Co, 217 N Detroit Ave, Tulsa, Okla.

### MAINTENANCE, SAFETY EQUIPMENT

★ **"How to Make Power Plant Cleaning** Easier." Two-color, 42-page handbook giving methods, solution concentrations and other

*(Continued on page 282)*



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**SUPERIOR COMBUSTION INDUSTRIES INC.**
TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

SUPERIOR
STEAM GENERATORS

# George Edwards' Scrapbook

*Trend of our times shows up nicely with a new use for an electronic computer. I just read about an aircraft carrier on which two electric generators had been replaced by a single, higher capacity unit. But the new generator vibrated increasingly as the ship picked up speed.*

*One way to solve the problem was to reinforce the structure supporting the generator and then observe the effects. Instead, the situation was simulated on a Boeing computer. Without touching a torch to the floor plates of the ship, 16 modifications were tried out in just five hours and one of them reduced the vibration by 47 per cent. So the supporting structure was changed as indicated and the problem was solved.*

* * *

The most important single ingredient in the **formula of success** is knowing how to get along with people.

—Teddy Roosevelt

* * *

*Some for the Glories of This World; and some*
*Sigh for the Prophet's Paradise to come;*
*Ah, take the Cash, and let the Credit go,*
*Nor heed the rumble of a distant Drum!*

*from the* "Rubaiyat of Omar Khayyam"

*Grow old along with me!*
*The best is yet to be,*
*The last of life, for which the first was made:*
*Our times are in his hand*
*Who saith, "A whole I planned,*
*Youth shows but half; trust God: see all, nor be afraid!"*

*from* "Rabbi Ben Ezra"—Robert Browning

* * *

*Omar was an eleventh century Persian poet and mathematician who didn't believe in waiting too long for his rewards, as you can see by these few lines from his Rubaiyat. On the other hand, Robert Browning, the English poet, had an opposite view. Take your choice.*

*'Sport' was the local character in my home town. Though he was always dressed up, he usually found little to do other than to sit around the village square. Sport did a lot of talking and one of his favorite expressions was, "Oh, this jerkwater town!"*

*Too bad no one ever thought of asking him just what he'd done to improve the town. In power plants since then, I've often run into Sport's counterpart and the crack, "Oh, this jerkwater plant!" But there were never any constructive thoughts or actions behind the crack.*

*Fortunately, most plant operators are constructive. I'm always impressed with the many ingenious hookups and practical aids built by plant men who've had little formal education. I guess they just don't have time to complain—they're too busy making improvements.*

---

*When I was a kid, most factories were put up to last a century or so. And they looked like institutions. Today, factories are built to be flexible, expandable and even demountable so they can change and grow as the manufacturing process itself changes and grows. Seems to me these are mighty good qualities for human beings to have—especially engineers.*

* * *

*I learned a lesson in public relations during a recent visit to Euclid, Ohio. Home owners there protested when Reliance Electric & Engineering Co put up a plant in a new residential area. But the company overcame the opposition by showing patience, cooperation and good faith. How? The firm built a park area of trees and grass exclusively for the residents' use as a 'buffer zone' between the plant and the homes.*

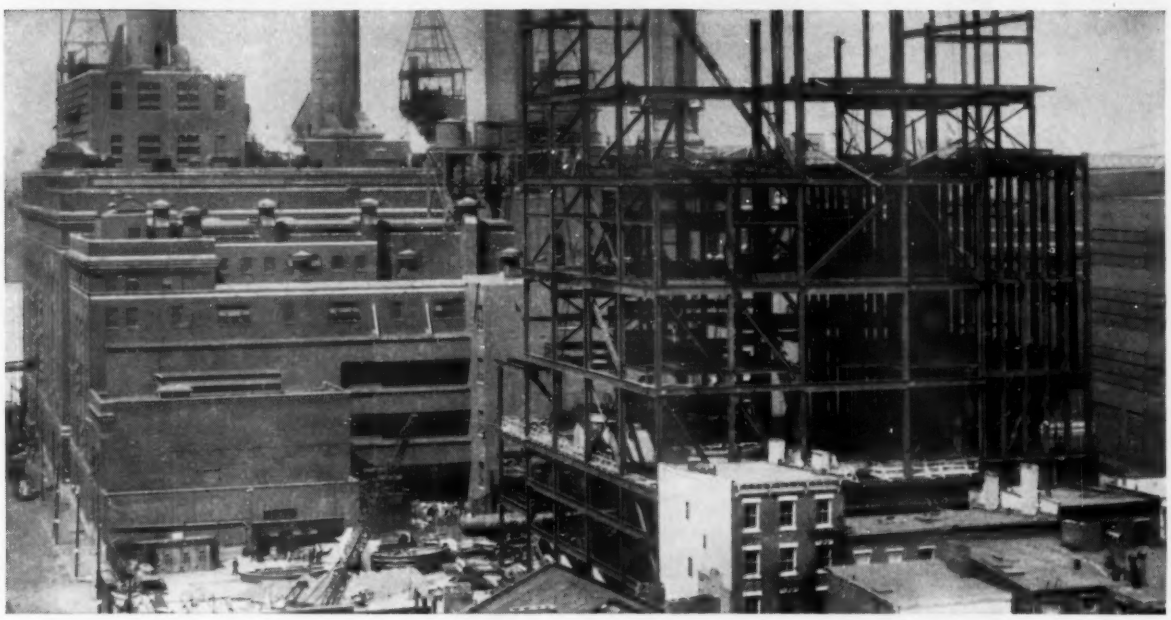
*But park's cost of $10,000 was worth it—the residents and their kids now use it for baseball, golf practice, bicycle riding and picnics. Just goes to show that public relations is nothing more than trying to see the other person's viewpoint and then doing something about it.*

George Edwards

*Engineer*

# CHEMICAL CLEANING REMOVED MILL SCALE FROM BOILER AFTER ERECTION

## Dowell service gave quick, effective cleaning assuring more efficient operation



To provide more extensive service for its customers, a large power company installed a new 1,370,000 lb. per hour boiler. Specifications on this equipment called for Dowell Chemical Cleaning Service to remove the mill scale from the boiler *after erection.*

To remove the mill scale, Dowell engineers filled the boiler with solvents especially designed for the job. Using Dowell's equipment, manpower, and pump trucks, the entire cleaning job was performed in a few hours.

The removal of mill scale *after* equipment is erected can eliminate much of the extra care required in the handling of previously sand blasted or pickled tubes. It may also substitute for the grease-removing alkaline pre boil, thus saving considerable time and money. Unless it is removed, mill scale may retard heat transfer, slough off abrading particles, and act as a base for further corrosion.

Maintenance engineers in industrial plants throughout the country have learned to rely on Dowell Service for fast, effective and economical cleaning of their operating equipment. How about you?

Experienced Dowell engineers are available to make estimates on your particular problems. Call Dowell today, or write directly to Tulsa, Dept. B-23.

# *DOWELL SERVICE*

***Over 100 Offices to Serve You with Chemical Cleaning for:***

Boilers • Condensers • Heat Exchangers • Cooling Systems
Pipe Lines • Piping Systems • Gas Washers • Process Towers
Process Equipment • Evaporators • Filter Beds • Tanks

*Chemical Services for Oil, Gas and Water Wells*

DOWELL INCORPORATED • TULSA 1, OKLAHOMA

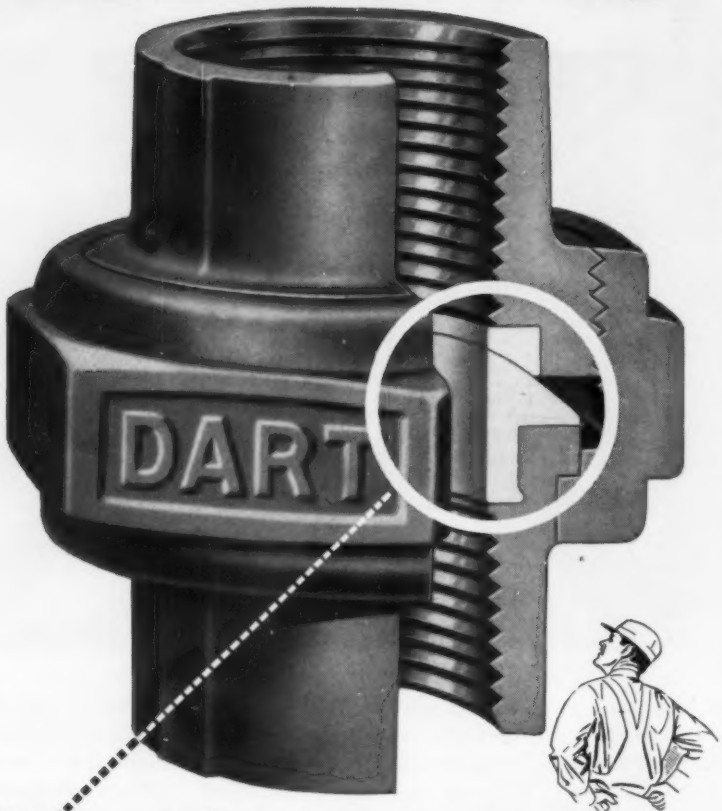
DOWELL

*A Service Subsidiary of*

THE DOW CHEMICAL COMPANY

## Dart Unions are

# LEAKPROOF




## This True Ball Joint Makes the Difference

You can't buy an *easier*-operating, *longer*-operating, more *positive*-operating union for *any* money

**QUICK FACTS**

- Leakproof because precision-machined to a true ball joint and spherically ground
- Extra wide bronze seats (Resist pitting and corrosion)
- Heavy shoulders (Take severe wrenching without harm)
- Nut and Body Practically Indestructible (They're air-refined, high test malleable iron)

See your supplier today

**DART**

**UNIONS**

**DART UNION COMPANY • PROVIDENCE 5, RHODE ISLAND**

*The Fairbanks Co. — Distributors: Boston • New York • Pittsburgh • Rome, Ga.*


# More EQUIPMENT NEWS

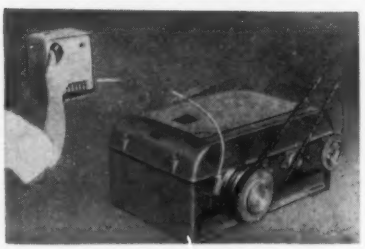
Begins on page 160

### Speed Control

**224** • Automatic speed control of *U. S. Varidrive Motors* by such variables as pressure, temperature, speed or liquid level is now possible through an improved pneumatic control called *Varitrol*. Designed to operate manually or automatically on supply air pressure of 60 to 100 psi, unit is applicable to manual speed, pressure, temperature liquid level and proportional flow control. Advantages of pneumatic control system include simple construction, adaptability to many types of signals, sensitivity and stability, ease of installation and servicing and inherent explosion-proof characteristics. *Varitrol* is currently available on *Varidrives* from 1 to 30 hp. Additional details from manufacturer.

**Electrical Motors, Inc, Box 2058, Terminal Annex, Los Angeles 54, Calif.**

For more data on these items, use post cards p 169. Identify your request with item number.



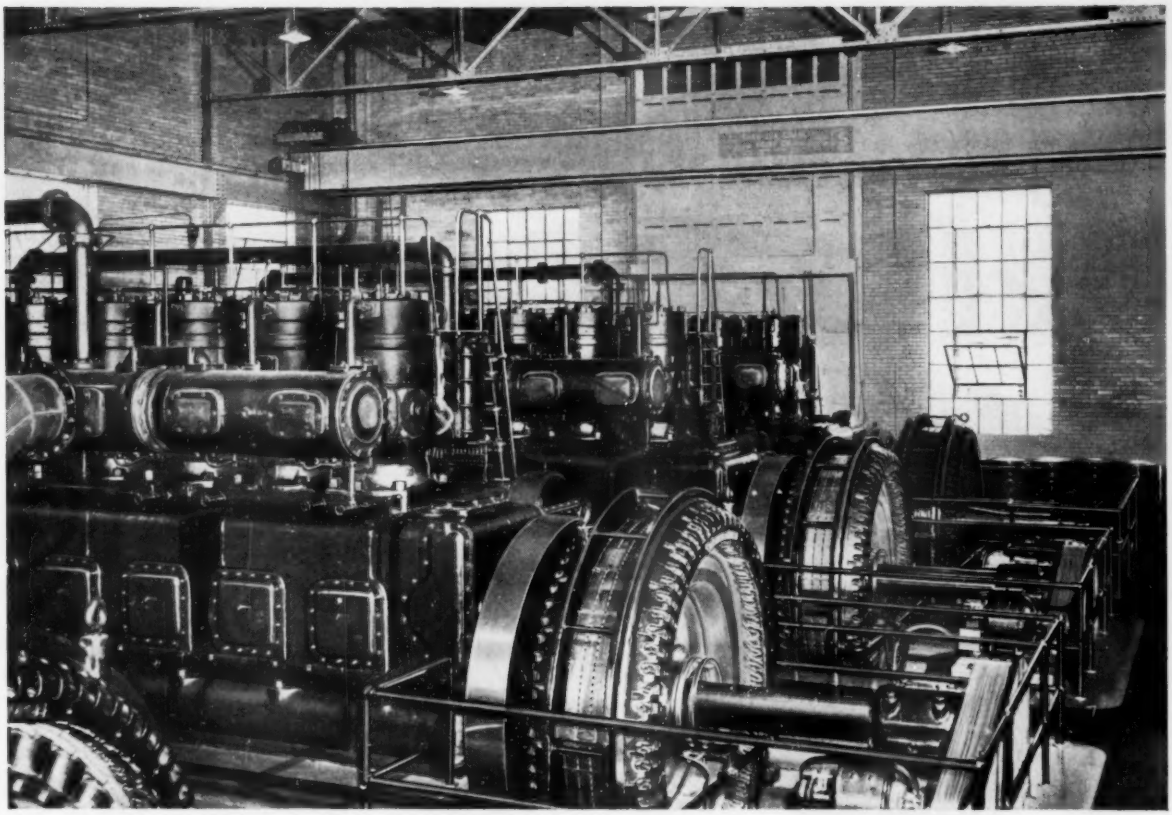
### Drive Combination

**235** • New combination of electric clutch and *Reeves* transmission provides versatile piece of equipment that prevents damage to fragile material and protects expensive machinery. Unit picks up light or heavy load with smooth cushioned application of torque from 0 to maximum. Electric clutch may be applied to either input or output shaft of transmission. In case of jam or overload, clutch acts as safety device for driven equipment. Complete details in manufacturer's bulletin G-537.

**Reeves Pulley Co, Columbus, Indiana**

### Drive Unit

**261** • New drive unit for fork lift trucks, *Towmotorque Drive*, gives operator more accurate, positive control of truck and, by



# "We're Proud of This Plant!"

says Don H. Decker, — Plant Supt., Thumb Electric Cooperative, Ubly, Mich.

Manager Orville Hurford and Mr. Decker are justifiably proud of their 4-diesel engine generating station. The plant has been an outstanding financial success since the day it was first opened. Several times it has occupied #1 position on the REA Running Plant capacity chart.

Mr. Decker writes, "A large part of our operating success we attribute to Sinclair GASCON® D oil. It has given us an excellent rate of consumption while reducing wear. In fact, *cylinder and piston ring wear is much below normal based on other plants of equal capacity*. Something else we appreciate is the timely visits of the Sinclair Lubrication Engineers."

Top quality lubricants plus the assistance of Sinclair Lubrication Engineers are two of the reasons why Sinclair can play a large part in the success of *your* operation. Your local Sinclair Representative will be happy to explain the remaining reasons. Phone him or write Sinclair Refining Company, 600 Fifth Avenue, New York 20, N.Y.

## SINCLAIR DIESEL LUBRICANTS

*save Wear and Replacement*

# For Quickest Pipe Threading by hand... it's "OOR"

RIDGID

## Popular Extra-Handy OOR Threads 1/8" to 1" Pipe Fast and Easily

- You just can't beat these small drop head dies for quick easy pipe or conduit threading.
- Snap the size head you want into the drive ring, from either side, and you're ready to cut clean perfect threads . . . heads can't fall out.
- Precision-cut alloy dies reverse easily for close-to-wall threads—no special dies needed.
- OOR and OR 1/8" to 1"; 111R and 11R, 1/8" to 1 1/4"; 12R, 1/8" to 2". Free carrier with sets. Every threader fully work tested before shipment. Buy them at your Supply House.

**THE RIDGE TOOL COMPANY • ELYRIA, OHIO**

RIDGID
Work-Saver Pipe Tools


## More EQUIPMENT NEWS

Begins on page 160

eliminating clutch, provides added economy in maintenance. Unit eliminates shifting of gears, provides smooth operation at all speeds and permits operator to switch from forward to reverse without coming to complete stop. Special *Creep Control* lets truck travel at low speed while engine operates at high speed to raise load. Information booklet available on request to manufacturer.

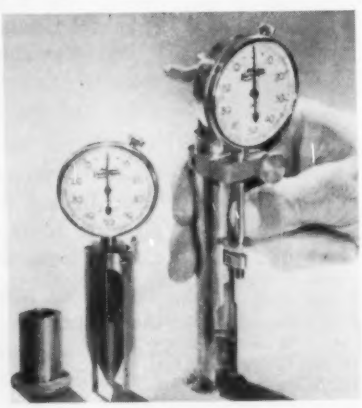
**Towmotor Corp, 1226 E 152nd St, Cleveland 10, Ohio**

### Hand Tachometer

**228** • New hand tachometer features novel thumb-operated range selector that automatically changes scale numbers for each range. Same mechanism also brings into view correct number of rpm's per scale division. Sub-divided scale is extra long to insure maximum readability. Different types of units and range-extending adapters are available to measure speeds from 2 to 100,000 rpm. Further details available from manufacturer.

**Metron Instrument Co, 432 Lincoln St, Denver 3, Colorado**

For more data on these items, use post cards p 169. Identify your request with item number.



### Valve Gapper

**264** • New precision instrument uses entirely new principle in setting valve clearance or *gap* on engines with overhead valves. Valve-gapper measures travel of rocker arm prior to contact with valve stem. Measurement is transmitted to dial gauge graduated

# The Small Valve

## THAT DOES THE

# BIG JOB

*Here's what you get:* Extra protection against excessive stress with new extra-strong stem and wedge-gate connection . . . super-hardened seat rings of stainless steel . . . forged body and yoke (and bolted follower that has no threads to corrode) . . . plus Malcomized gate faces that won't seize or gall. Made in sizes from ½″ to 2″ inclusive, with choice of rising stem with yoke, or with inside screw. Bonnet joints either gasketed or metal-to-metal. Pressure range: 2,000 lb. at 100°F. — 380 lb. at 1,000°F. For higher pressures, specify List 990. Write for Catalog 10.

**The CHAPMAN VALVE MFG. COMPANY**

**INDIAN ORCHARD, MASS.**

# LIST 960

# CHAPMAN

# THERE'S MORE FOR YOUR MONEY··IN

# PANALARM "50" ANNUNCIATOR SYSTEMS

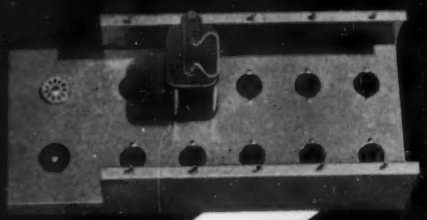
No annunciator system ever offered as much in value as PANALARM "50".

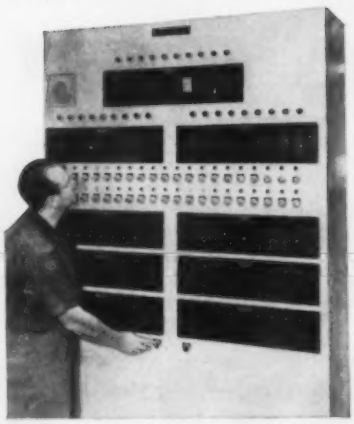
Examine for yourself every piece and component . . . consider the savings you realize through standardization and complete flexibility that only PANALARM "50" provides.

Then, evaluate *dependability*. Beyond all else, PANALARM "50" represents the greatest value in audio-visual alarm systems by its record of *dependable service* alone.

## STANDARD CHASSIS

is interchangeable without re-wiring for all types of annunciator service: standard audio-visual; ringback; bullseyes or name-plates; trouble or running signals; lock-outs; or low drain operation.





## PANALARM IS PROVEN!

In hundreds of plants—serving for many years—Panalarm Annunciators have demonstrated outstanding performance. They have won confidence for the very critical part they play in plant operation and safety.

## PANALARM PLUG-IN UNITS

. . . *heart of the system* . . . incorporate finest telephone-type relays and special contact arrangements . . . assure sequential operation. Hermetically sealed suitable for Class I, Div. 2 locations.

SEND FOR COMPLETE MANUAL.
Ask for Catalog 100-A

PANALARM PRODUCTS, INC.
6312 North Broadway • Chicago 40, Illinois

PANALARM®

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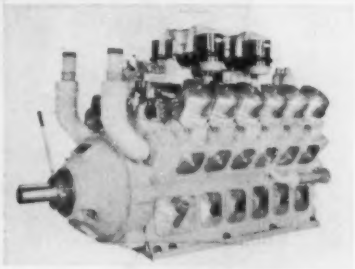
# More EQUIPMENT NEWS

Begins on page 160

in thousandths of an in. Easy-to-read dial permits positive visual setting of valve clearance regardless of wear or pitting of rocker arm. Further details available from manufacturer.

**P & G Mfg Co, 2262 N Albina Ave, Portland 12, Oregon**

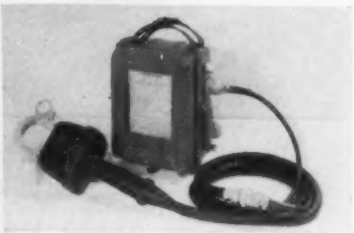


### V-12 Engine

**215** • Powerful new V-12, valve-in-head engine is recommended for heavy sustained loads. Burning low-cost natural gas, *L4000* is best suited to operations where dependable power must be delivered at minimum operating and maintenance costs. Unit can be equipped for burning liquified petroleum gas, sewer gas or gasoline. Other features include hardened steel valve inserts, "zero lash" hydraulic valve lift, water-cooled manifolds, full pressure lubrication and modern cam ground aluminum pistons. Further details from manufacturer.

**LeRoi Co, 1706 S 68th St, Milwaukee 14, Wisconsin**

For more data on these items, use post cards p 169. Identify your request with item number.



### Recording Volt-Ammeter

**211** • New portable recording instrument for obtaining permanent record of alternating current and voltages is particularly useful for checking loads on distribution lines, verifying motor loads, and detecting overloads in various ac apparatus. Unit combines features of self-latching, multi-range, hook-on current transformer with simplicity *Type CF* inkless recorder in equipment suitable for both indoor and outdoor applications. Further details from manufacturer.

**General Electric Co, Schenectady 5, New York**

### Weld Strength Calculator

**262** • Unique weld strength calculator consists of durably-made plastic slide rule that indicates both size of weld required for given applied load and weight of given

## NO GETTING AROUND IT!

# A De Laval Centrifuge Costs Much Less Than "Down" Time

The cost of a De Laval Centrifugal Oil Purifier of any given size is only a fraction of the cost of the prime mover it protects. There's no denying it, the comparatively modest investment represented by a De Laval Oil Purifier is far outweighed by the cost of even one serious shutdown. A De Laval machine is truly inexpensive insurance.

A De Laval Oil Purifier instantaneously removes from lube oil, all water, dirt or sludge by means of centrifugal force, keeping the oil clean and safe. The water is discharged continuously. Moreover, every De Laval machine correctly selected for size in the first place, has ample reserve capacity to take care of a sudden water leak.

Naturally, any solid contamination is thrown out of the oil and stored out of the zone in which purification takes place.

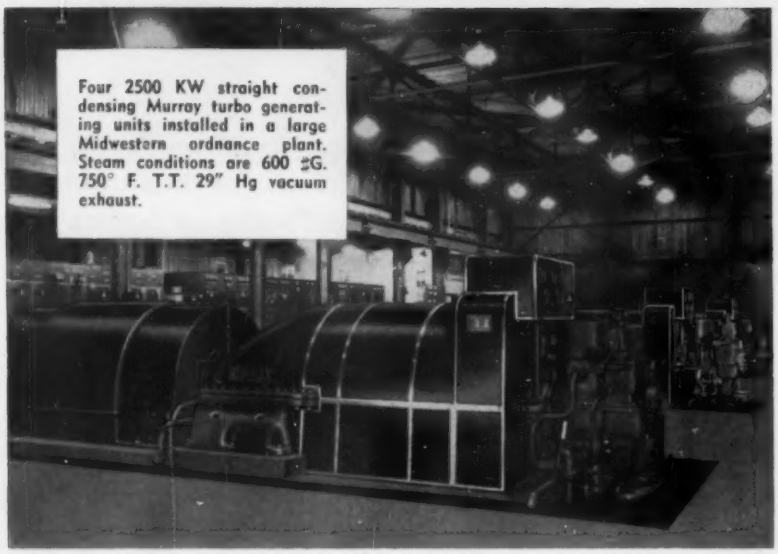
**De Laval protection is *complete* protection!**

**DE LAVAL**

**THE DE LAVAL SEPARATOR COMPANY**
Chicago POUGHKEEPSIE, N.Y. San Francisco

**FOR MORE DEPENDABLE POWER PRODUCTION**

# Murray Turbines



Four 2500 KW straight condensing Murray turbo generating units installed in a large Midwestern ordnance plant. Steam conditions are 600 #G. 750° F. T.T. 29" Hg vacuum exhaust.

● Murray Turbo Generator units can be furnished to meet your special requirements in sizes up to 3000 KW. Condensing and non-condensing types with or without extraction and/or mixed pressure features can be furnished. Whether you require a small inexpensive standby unit or a highly efficient, and reliable source of power, Murray has a design to fit your needs.

Consult your local Murray representative who will gladly help you select the unit most economically suited to your conditions.

**MURRAY IRON WORKS COMPANY**
**BURLINGTON, IOWA**

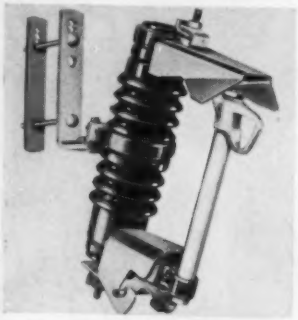
**BUILDERS OF STEAM POWER EQUIPMENT FOR THREE-QUARTERS OF A CENTURY**


## More EQUIPMENT NEWS

Begins on page 160

length of weld in lb. A companion tool to Lukens' plate size selector, device gives stress values ranging from 2000 to 20,000 psi and applied loads of from 9000 to 450,000 lb.

**Lukens Steel Co, Coatesville, Pa.**

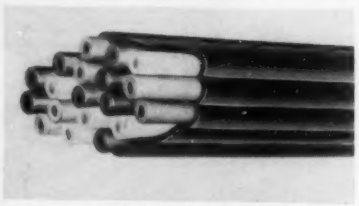


### Fuse Cutouts

**236** • New line of open dropout fuse cutouts for use on 5.2, 7.7 and 15-kv distribution systems will accommodate standard or heavy fuse holder or disconnect blade. Standard cutout fuse will interrupt 3000 a at 5.2 and 7.8 kv, and 2000 a at 15 kv. Heavy duty model will handle 5000 and 4000 a respectively. Both sizes have 100-a continuous current rating, while disconnect blade has 200-a rating. Further details from manufacturer.

**Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pennsylvania**

For more data on these items, use post cards p 169. Identify your request with item number.



### Tubing Harness

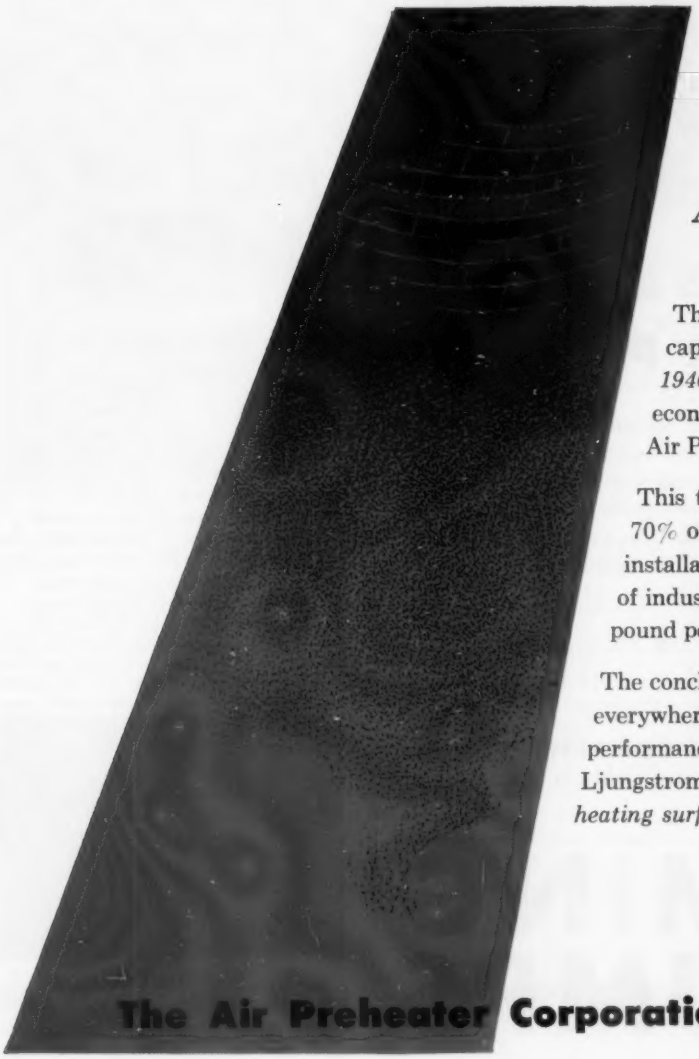
**223** • *Dekoron Impervapak Poly-Cor,* a patented instrument tubing harness, is now available with color-coded lines. Color coding simplifies installation of instrument lines, eliminates necessity for identifying individual lines by such means as applying compressed air to one end of a long run of tubing. Material is available with 4, 7, 10, 14 or 19 tubes with individual lines coded in black, red, blue or green. Full information and technical data available from manufacturer.

**Samuel Moore & Co, Mantua, Ohio**

### Fluid-shaft Motors

**263** • New range of fluid-shaft motors, in frame sizes as low as No. 203, incorporates newly-designed *midget* fluid coupling for use on ratings from ½ through 1 hp. Internal coupling feature greatly reduces both cost and space of separate units. Smooth load acceleration, protection against equipment "jamming" and an ability to start

# 420,000,000 pounds of steam per hour



*served by*

**LJUNGSTROM**

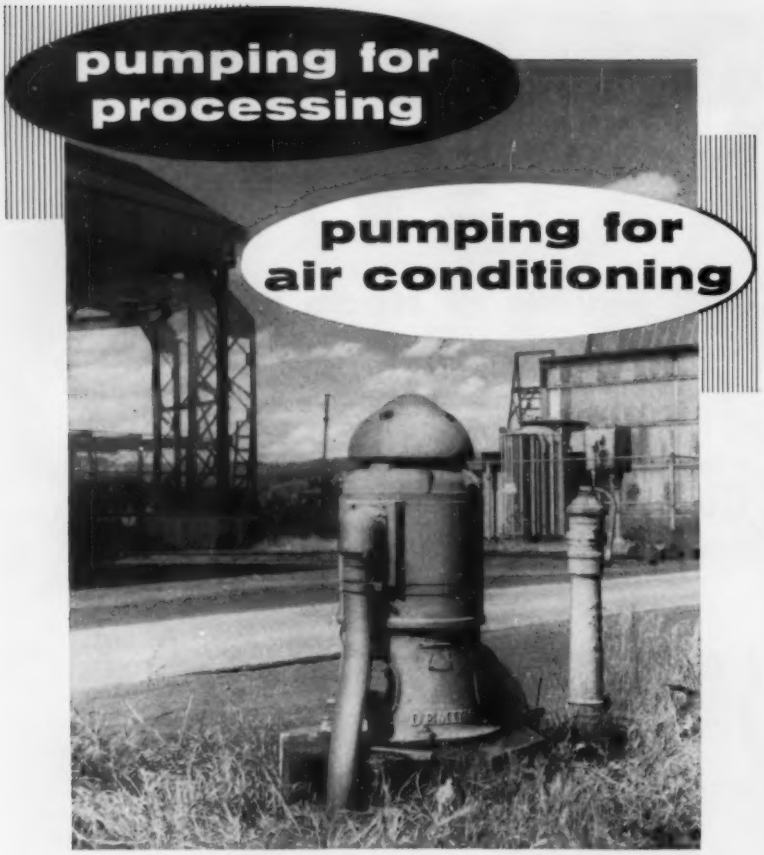
*Air Preheaters*

That's the amount of new steam capacity, installed or on order *since 1946 alone*, designed to utilize the economies available with the Ljungstrom Air Preheater.

This total capacity includes nearly 70% of all new central station boiler installations, as well as the major portion of industrial boilers in the over-250,000 pound per hour range.

The conclusion is obvious: Boiler users everywhere realize that the fuel-saving, performance-boosting abilities of the Ljungstrom make it the *most economical heating surface on the modern boiler.*

**The Air Preheater Corporation** 60 East 42nd Street, New York 17, N. Y.




*multi-duty* **SERVICE with DEMING PUMPS**

Pumping well water at a temperature of 52° for air conditioning and then to a central reservoir for other factory uses is the multi-duty service of five Deming Vertical Turbine Pumps at a Remington-Rand plant in Elmira, N. Y. Installed in 1942, three of the pumps operate 9 hours a day and two pumps run continuously. Since 1942, only one of the five pumps has been pulled for maintenance.

*Send for* **BULLETIN NO. 4700-51**

Important facts about Deming Vertical Turbine Pumps are in this illustrated bulletin.

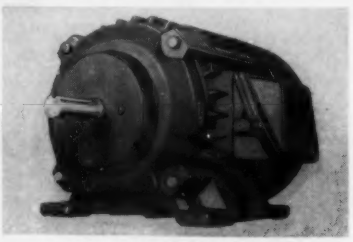
**THE DEMING COMPANY**
**547 Broadway • Salem, Ohio, U. S. A.**

*Specify* **DEMING PUMPS**


# More EQUIPMENT NEWS

Begins on page 160

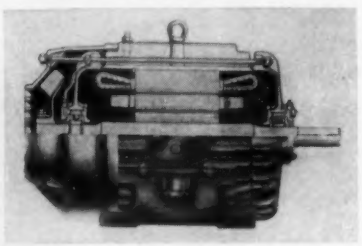
heavier loads are additional features. Additional details available from manufacturer.
**Reuland Electric Co, Alhambra, Calif.**



### Ac Motors

**219** • New line of well-protected, versatile, squirrel-cage induction motors includes protected and enclosed motors for all industrial purposes and meets recently adopted NEMA standards. First of new units to appear will be for 1, 1½ and 2-hp applications in frame sizes 182 and 184. Remaining units, up to and including 30 hp, will appear at regular intervals throughout 1954-55. Further data available on request to manufacturer.

**Reliance Electric & Engrg Co,**
**1088 Ivanhoe Rd, Cleveland 10, Ohio**

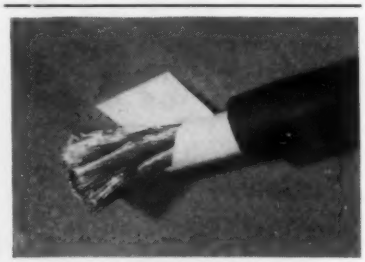


### Corrosion-Resistant Motors

**237** • Totally-enclosed, fan-cooled ACEC motors provide full protection to all motor parts against particularly harmful atmospheres. Specially designed for outdoor applications, this motor is ideally suited to moist, dirty or corrosive atmospheres. Manufactured to meet rigid ACEC and NEMA specs, *Type AK* general purpose motor provides economy both in original investment and in operation and maintenance. Further details available from manufacturer.

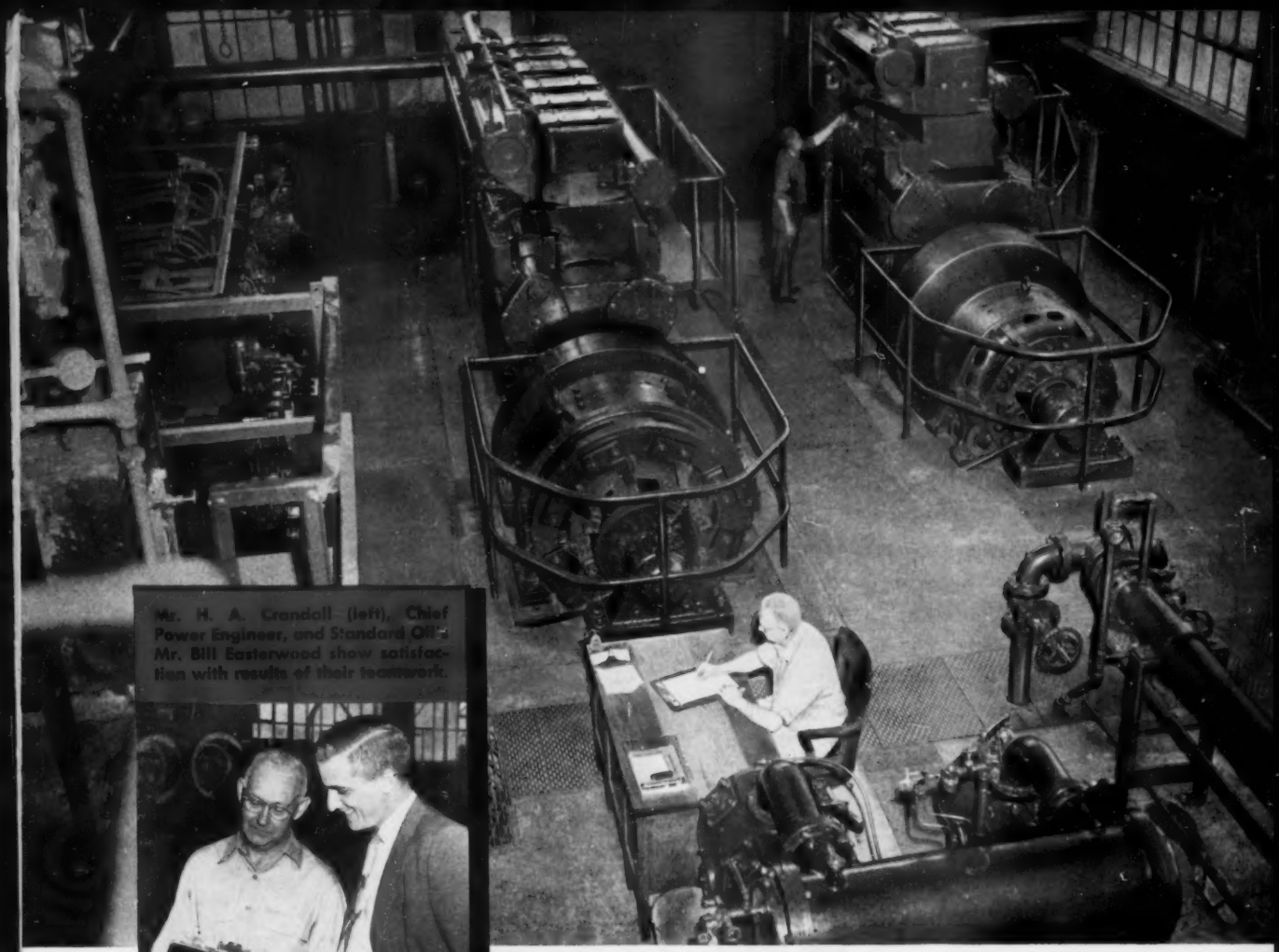
**Belgian Electric Sales Corp,**
**40 E 49th St, New York, N. Y.**

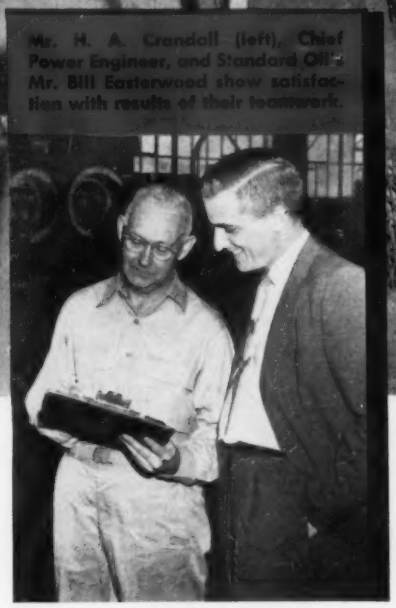
For more data on these items, use post cards p 169. Identify your request with item number.



### Welding Cable

**220** • New all-purpose arc-welding cable features tough *Neoprene* compound that





Mr. H. A. Crandall (left), Chief Power Engineer, and Standard Oil's Mr. Bill Easterwood show satisfaction with results of their teamwork.

## Here's a 27,000-hour record for low wear and clean operation!

● This diesel power plant serves a large midwest manufacturer of steel products.

The plant superintendent was increasingly aware that lubrication of his two diesels was not all that it should be. There was trouble with stuck rings, and crankcases showed excessive deposits. Working with a Standard Oil lubrication specialist, the superintendent switched his engines to STANDARD HD Oil.

During some 27,000 hours' operation of each unit, engines have remained exceptionally clean. Ring sticking troubles have been eliminated. Cylinders have shown less than 0.01" wear — a reduction of 50% over the previous, similar period. Neither of the original fills of STANDARD HD have needed to be replaced.

Midwest diesel operators are getting record efficiency and economy with the help of STANDARD HD. Your Standard Oil lubrication specialist can help you get similar results. Phone your local Standard Oil office. Or, write: Standard Oil Company, 910 South Michigan Ave., Chicago 80, Ill.

STANDARD HD
TRADE MARK
OIL

**STANDARD OIL COMPANY**

STANDARD (Indiana)

# This NEW METHOD DRIES AIR

## PRECISELY as you want it

- to control your product's quality
- to prevent condensation on your product or material
- to prevent changes due to moist air in contact with your product
- to protect your material from dampness
- to protect your processing of moisture-sensitive material
- to DRY your material or product
- to pack or store your product safe from moisture damage
- to get exact moisture control for the precise atmosphere condition you need
- to provide precise atmospheric conditions for testing
- to increase your air conditioning capacity
- to DRY large quantities of fresh air from outdoors

***The Niagara's Controlled Humidity Method using HYGROL moisture-absorbent liquid is***

**Best and most effective because . . .** it removes moisture as a separate function from cooling or heating and so gives a precise result constantly and always. Niagara machines using liquid contact means of drying air have given over 20 years of service.

**Most reliable because . . .** the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions.

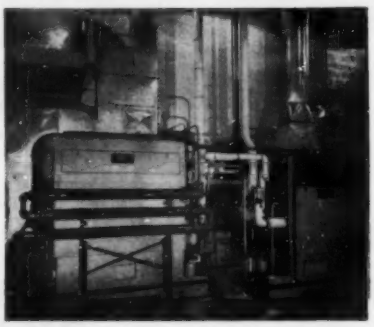
**Most flexible because . . .** you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

**Easiest to take care of because . . .** the apparatus is simple, parts are accessible, controls are trustworthy.

**Most compact,** taking less space for installation.

**Inexpensive to operate because . . .** no re-heat is needed to obtain the relative humidity you wish in normal temperature ranges and frequently no refrigeration is used to remove moisture.

**The cleanest because . . .** no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.



**Niagara Controlled Humidity Air Conditioning**

This method removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the leaving air. Heating or cooling is done as a separate function.

*For complete information write*

**NIAGARA BLOWER COMPANY**

**Dept. P, 405 Lexington Ave., New York 17, N. Y.**

*District Engineers in Principal Cities of United States and Canada*


# More EQUIPMENT NEWS

*Begins on page 160*

gives it greater durability under severe service conditions. Cable has high resistance to heat, hydrocarbons, oils and greases and acid attack. Jacket compound meets ASTM Specification D-752. Cable is packed in 250-ft coils or 1000-ft reels and is furnished in sizes from No. 6 to No. 4/0.

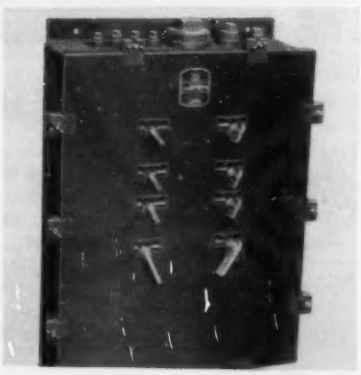
**Dalweld Co, 1 Bertel Ave, Mount Vernon, New York**

### Sealed Ignitrons

**229** • New sealed-ignition mercury-arc rectifier can rectify 1000 kw at 250 v dc or 1500 kw at 600 v. Unit uses only six tubes each of which is only 12 in. in dia. Tubes are designed so welds can be cut, tube repaired and then rewelded—a factory operation that makes tube as good as new. Light enough to be handled by two men and enclosed in compact enclosed cubicles, new tubes simplify rectifier installations in industrial plants.

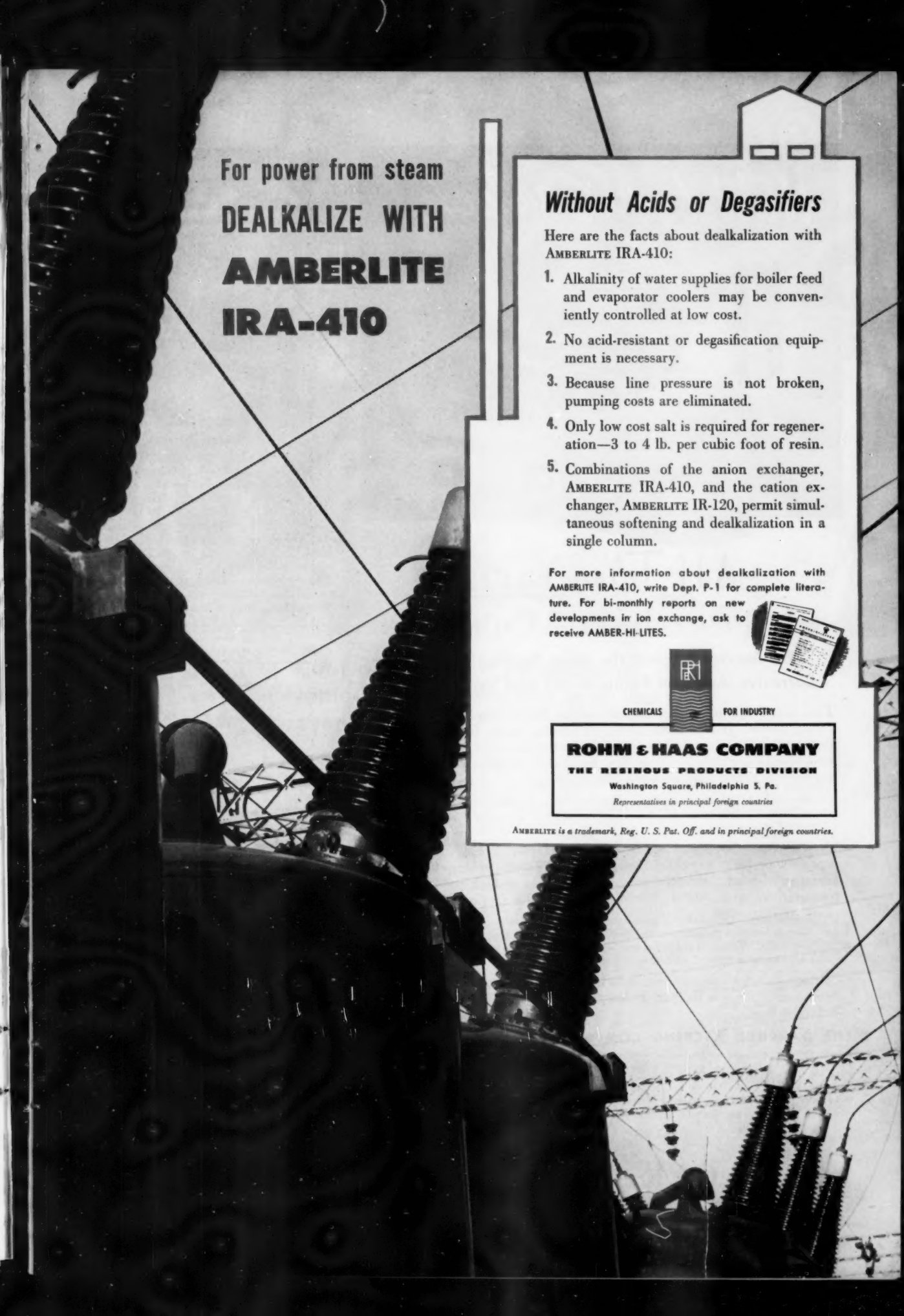
**Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pennsylvania**

For more data on these items, use post cards p 169. Identify your request with item number.



### Dust-tight Panelboards

**241** • Completely new line of dust-tight circuit-breaker lighting and distribution panelboards are specially designed for use in locations where dangerous combustible dusts are present. Units meet National Electrical Code requirements and standards for Class II, Groups E, F and G hazardous locations. All panelboards incorporate thermal-magnetic, quick-make, quick-break



For power from steam

# DEALKALIZE WITH AMBERLITE IRA-410

## *Without Acids or Degasifiers*

Here are the facts about dealkalization with AMBERLITE IRA-410:

1. Alkalinity of water supplies for boiler feed and evaporator coolers may be conveniently controlled at low cost.
2. No acid-resistant or degasification equipment is necessary.
3. Because line pressure is not broken, pumping costs are eliminated.
4. Only low cost salt is required for regeneration—3 to 4 lb. per cubic foot of resin.
5. Combinations of the anion exchanger, AMBERLITE IRA-410, and the cation exchanger, AMBERLITE IR-120, permit simultaneous softening and dealkalization in a single column.

**For more information about dealkalization with AMBERLITE IRA-410, write Dept. P-1 for complete literature. For bi-monthly reports on new developments in ion exchange, ask to receive AMBER-HI-LITES.**

CHEMICALS FOR INDUSTRY

**ROHM & HAAS COMPANY**

**THE RESINOUS PRODUCTS DIVISION**

Washington Square, Philadelphia 5, Pa.

*Representatives in principal foreign countries*

AMBERLITE *is a trademark, Reg. U. S. Pat. Off. and in principal foreign countries.*

# All Teflon† Yarn
## LATTICE BRAID* PACKING

**For Service Against the Most Destructive and Corrosive Acids on Pump Shafts and Valve Stems**

THIS new Teflon packing is *not* just another braided packing made from Teflon ribbon. It is a *totally* different packing made from an all-new Teflon yarn. The yarn is woven tightly by the patented LATTICE BRAID method into a relatively dense, firm braid with no large voids. Garlock can furnish Teflon yarn packings in two styles—

**No. 5883 LATTICE BRAID** packing—composed 100% of Teflon yarn.
**No. 5888 LATTICE BRAID** packing—composed of 100% Teflon yarn and treated with Teflon suspensoid.

They are furnished in coil and ring form in sizes 1/8" to 1½". Both packings are superior to any other types of braided Teflon packings for service against the *most* destructive or corrosive acids at high pressures and temperatures up to 500° F. For example, note this service report—

Duplex pump, 1⅝" shaft, ⅜" packing size, pumping sulfuric acid at 12,000 p.s.i. New Teflon yarn packing was installed. Customer reports that *after 1400 hours* they added 2 rings and are still operating. (Best prior service was 330 hours with a blue asbestos braided packing with Teflon suspensoid.)

Contact a Garlock representative at the sales office nearest you. Get his recommendations on the new Teflon yarn packings and on other Garlock Teflon products.

**THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK**

**Branch Offices:** Baltimore • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Cleveland Denver • Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N.Y.) • Philadelphia Pittsburgh • Portland (Ore.) • Salt Lake City • San Francisco • St. Louis • Seattle Spokane • Tulsa

**In Canada:** The Garlock Packing Company of Canada Ltd., Toronto, Ont.

*Registered Trademark. †du Pont's Trademark for its tetrafluoroethylene resin.

GARLOCK

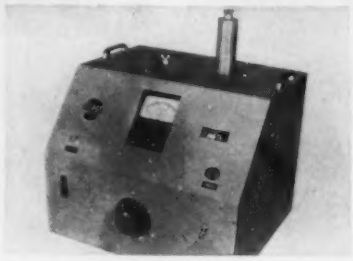
PACKINGS, GASKETS, OIL SEALS
MECHANICAL SEALS
RUBBER EXPANSION JOINTS


# More EQUIPMENT NEWS

Begins on page 160

circuit breakers for ac-dc service. Complete details available from manufacturer.

**Square D Co, 6060 Rivard St, Detroit 11, Michigan**



### Insulation Tester

**221** • Designed for testing up to 30,000 v ac, new semi-portable insulation tester features compactness and portability. Output voltage is continuously variable from 0-30,000 v at 1 kva capacity. Input is 115 v, 50-60 cycles. Reset primary circuit-breaker with secondary trip provides short circuit protection. Applications include testing of motors, cables, transformers, insulators, etc. Complete data available from manufacturer.

**Associated Research, Inc, 3796 W Belmont Ave, Chicago 18, Illinois**

For more data on these items, use post cards p 169. Identify your request with item number.

### Lighting Units

**232** • New and completely redesigned line of 6-v emergency lighting equipment features two UL-approved auxiliary lighting units. Each unit has one 25-w sealed-beam lamp but is available with two if desired. In event of power failure, one-lamp unit of both models will furnish more than 8 hours of uninterrupted emergency lighting.

Under normal circumstances batteries in both models are kept fully charged from normal ac supply by means of built-in trickle charger. During power failure, electrically actuated relay closes to provide emergency lighting until normal power is restored. Charging resumes automatically. Further details from manufacturer.

**Electric Storage Battery Co, 42 S 15th St, Philadelphia 2, Pa.**

### Midget Solenoid Valves

**265** • Broadened line of Midget 2- and 3-way solenoid valves includes types with explosion-proof solenoids suitable for Class

# This building was "protected" too.

## Explosion Collapses Stack Wrecks Plant

A violent Flame-Failure explosion at the [redacted] Dairy completely wrecked the boiler room, and collapsed the brickstack. The stack, raised in the air by the explosion, fell through the roof, severely injuring many.

The cause of the explosion was fuel pouring in unchecked after burner Flame-Failure, and igniting on hot fire brick.

## but— like 4 out of 5 burner installations, the Flame-Failure Protection was too slow to prevent explosion!

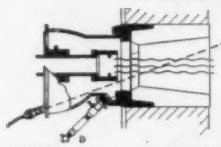
Most plants and buildings have flame-failure protection of some kind — and *think* they are safe. The fact is, however, that 4 out of 5 plants burning oil, gas or coal simply do not have Flame-Failure protection that meets insurance company standards. Your burners should have safeguards that shut off fuel in 2 to 4 seconds after a burner flame-failure. Explosive gases collect fast — faster, actually, than any human or mechanical "safeguard" can act.

Today, it is unnecessary to depend on slow, half-safe controls. It costs so little to replace them with the modern FIREYE System — the only fully approved, complete and instantaneous safeguard for all types of fuels. With FIREYE, an electronic eye "sees" the burner flame . . . and if the flame fails, it works with the speed of light to cut off fuel and warn operating personnel. FIREYE Systems are quickly and easily installed, and the cost is low.

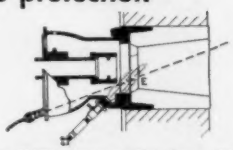
**BE SAFE! SEND TODAY!** Send now for this authoritative guide, compiled by the pioneers of *instant* electronic Flame-Failure protection. Long experience in the research and manufacturing of FIREYE Flame-Failure safeguards makes Combustion Control Corporation the one company best qualified to write on this subject — the one company offering you Firetron, the Flame-Failure sensitive cell that sets the standard of dependability.

**COMBUSTION CONTROL CORPORATION**
**Dept. PB-2 • • 718 Beacon Street, Boston, Mass.**

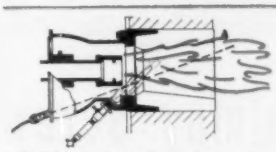
### How fireye gives you complete flame-failure protection



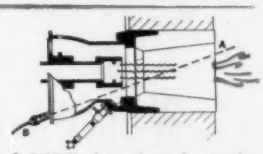
1 FIREYE purges combustion chamber (C) before igniting pilot (D) . . . to eliminate any gases accumulated from leaking valve during down time.



2 FIREYE proves pilot flame (E) before turning on main fuel. Pilot may have failed to light because of fouled electric ignitors, no fuel, or poor fuel-air mix.



3 FIREYE shuts down burner if main flame (A) is not ignited at end of safe trial period (due to no fuel, poor fuel-air ratio, or incorrect draft.)



4 FIREYE shuts down burner in 2 to 4 seconds if main flame fails due to poor fuel-air ratio or draft, or fuel interruption. POSITIVELY PREVENTS EXPLOSION.

fireye®

*FIRST and FOREMOST IN INSTANT FLAME-FAILURE PROTECTION*

# WARREN-QUIMBY

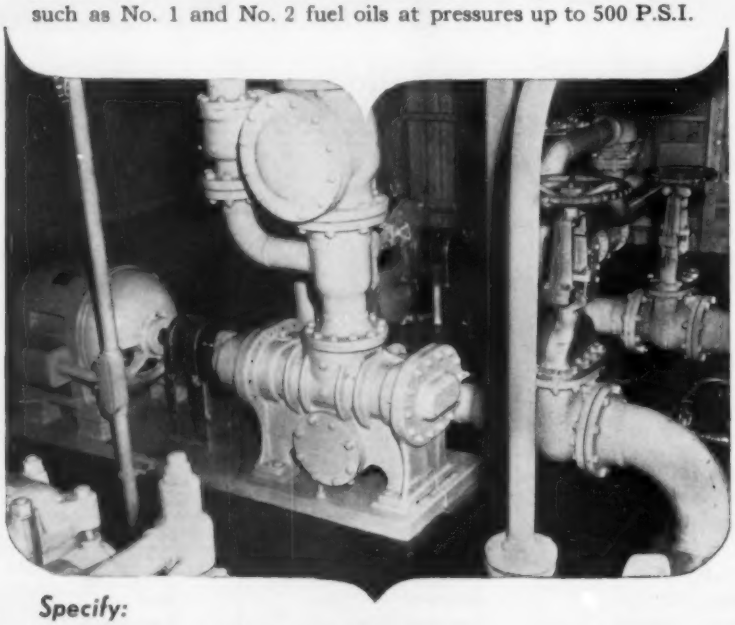
## Standard Gear-In-Head Screw Pump on Fuel Oil Unloading Service at FLORIDA POWER CORPORATION

Avon Park Station

This type of Warren-Quimby Screw Pump has long been in successful service in the handling of fuel oils, lube oils and various other lubricating liquids. It is essentially a pump for high pressure applications and is available in three general types of construction:

1. **Anti-friction bearing design**
2. **Anti-friction bearings with fixed center bearing**
3. **Sleeve bearing design**

Also, a Long Body Gear-In-Head Pump is built for high pressures when handling light hydraulic oil and other applications for pressures up to 1000 P.S.I., and for very low viscosity liquids, such as No. 1 and No. 2 fuel oils at pressures up to 500 P.S.I.



*Specify:*

## Warren-Quimby Screw Pumps

• *First in America* • *First in Dependability* • *First in Preference*

WARREN QUIMBY PUMPS

PQ-4

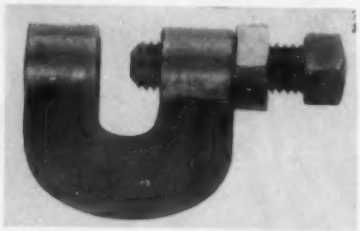
WARREN STEAM PUMP COMPANY, INC.
Warren, Massachusetts


## More EQUIPMENT-NEWS

*Begins on page 160*

1 Group D hazardous locations. Solenoid enclosures are of cast iron with ½-in. threaded conduit connections; conduit boxes rotate 360 degrees. Standard voltages for both valves are 115 or 230 ac, 60 cycles and 115 dc. Further data available in manufacturer's bulletins EP 8262 and EP 8314.

**Automatic Switch Co, Orange, N. J.**

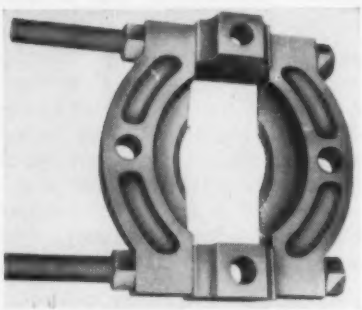


### I-Beam Clamp

**231** • Adjustable, vibration-resistant I-Beam clamp provides excellent fatigue-resistant characteristics for long trouble-free service. Used in conjunction with 2-section, split-ring, clevis-type pipe hangers, unit affords easy erection of all piping systems and greatly simplifies maintenance and layout changes. Clamp body, formed of 9-gauge steel, is 2⅜x2⅜ with ¾-in. opening. Lower jaw, threaded to receive hanger rods, is available in four sizes. Further details from manufacturer.

**Globe Stamping Division, Hupp Corp, Cleveland, Ohio**

For more data on these items, use post cards p 169. Identify your request with item number.



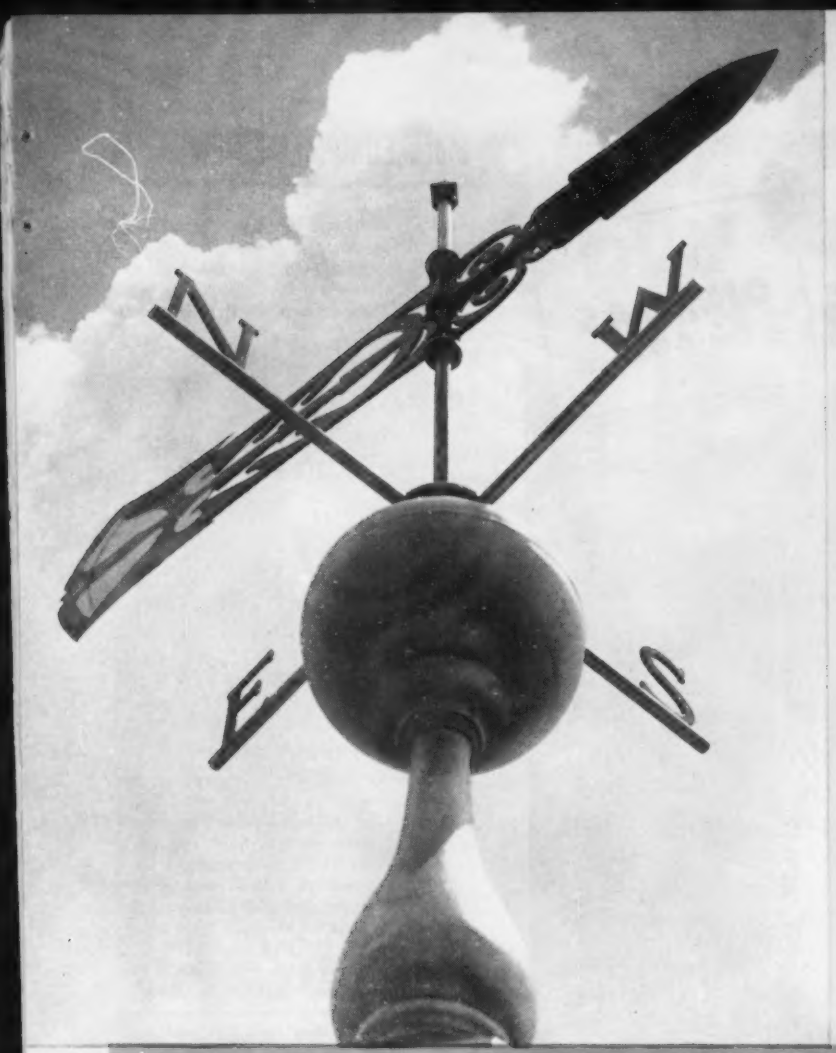
### Pulling Attachments

**266** • Two new large size pulling attachments are available for use with standard pullers or push-pullers. Units facilitate removal and installation of large bearings, gears, pulleys, sheaves, etc. Largest size has capacity from 6¾ to 16 in. Pulling tees into which legs are threaded more evenly distribute load under extreme pressure thus reducing danger of distortion to a minimum. Full details available from manufacturer.

**Owatonna Tool Co, 378 N Cedar St, Owatonna, Minnesota**

### Solvent Spray Gun

**267** • New spray gun cleans by solvent, emulsion or aqueous solutions. Unit draws cleaning fluid directly from a 55-gal drum and eliminates time lost in filling small



# A Four-Way Selection

This photograph of a weather vane seems a good way to point out the fact that there are four different types of Midwest Welding Elbows (see below). These are more types than are manufactured by any other company. This greater selection is important to users of welded piping because it gives the engineer greater latitude in piping design and permits improvements and economies not otherwise possible in welded piping systems. For more information on this subject, ask for Catalog 54.


**MIDWEST PIPING COMPANY, INC.**

Main Office: 1450 South Second Street, St. Louis 4, Mo.

*Plants: St. Louis, Passaic, Los Angeles and Boston*

Sales Offices:

New York 7—50 Church St. • Chicago 3—79 West Monroe St.

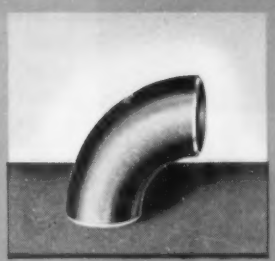
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.

Tulsa 3—224 Wright Bldg. • Boston 27—426 First St.

*STOCKING DISTRIBUTORS IN PRINCIPAL CITIES*

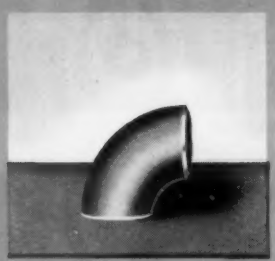
**MIDWEST "LONG TANGENT"**

Same radius as ASA but tangent equal to 25% of nominal pipe size on each end. Saves pipe, layout and welding time. Costs no more than ASA. Sizes to 36".



**ASA STANDARD**

Dimensions conform to applicable size range of American Standard for Butt-Welding Fittings. ASA B16.9. Tolerances much less than allowable. Sizes to 36".



**SHORT RADIUS**

Recommended where space is limited. Sizes to 30". Also available with "Long Tangents" in sizes 14" to 36".

**MIDWEST REDUCING**

Takes the place of a straight size elbow and a reducer. Eliminates one weld, reduces pressure drop, easier to insulate. Sizes to 16", reductions to half size.

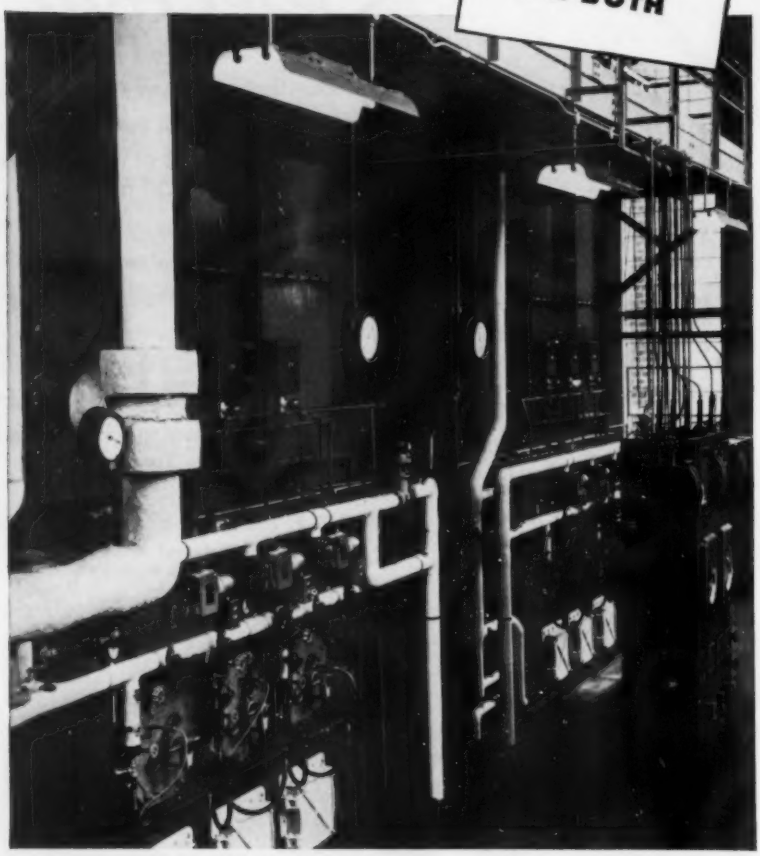
# MIDWEST WELDING FITTINGS

## IMPROVE PIPING DESIGN AND REDUCE COSTS

6105

# ENCO BURNERS

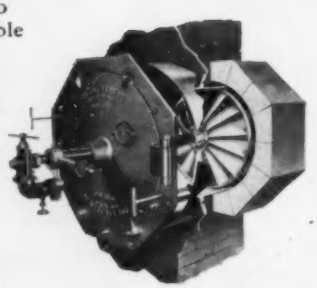
FOR OIL, GAS OR BOTH



This New England textile mill uses Enco Type K oil burners. When gas is available a gas-burner gun can be added for dual fuel firing.

Combustion in any case is uniform even if steam demands fluctuate suddenly—another economy feature.

This is only one example of economy with Enco Burners—made in sizes and types for every power plant need, including those with very wide load swings. Ask for literature or a special recommendation for your specific, individual oil or gas burner needs. We will give it the benefit of 35 years' experience in solving unique burner problems.



Enco type K oil burning unit

EC-488

**THE ENGINEER COMPANY**

75 WEST STREET, NEW YORK 6, N. Y.

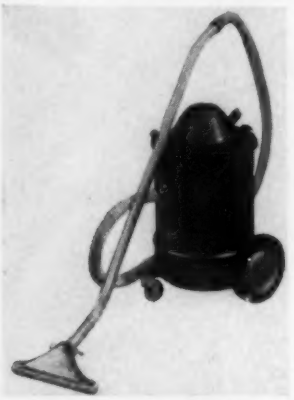
IN CANADA: ROCK UTILITIES LTD., 80 JEAN TALON ST. W., MONTREAL, P. Q.


## More EQUIPMENT NEWS

Begins on page 160

supply cans. Gun is recommended for cleaning electric motor parts and stator-frames, engines and engine-compartments and other mechanical equipment.

**John B Moore Corp, Nutley 10, N. J.**



### Vacuum Machine

**263** • New heavy duty vacuum cleaner offers appreciable saving over wet-and-dry vacuums. Unit features enclosed motor, efficient turbine-fan design, quiet operation. Overall weight of 52 lb guarantees easy handling. Numerous attachments enable machine to do a variety of cleaning jobs. Complete information available from manufacturer.

**Hild Floor Mahine Co, 740 W Washington Blvd, Chicago 6, Illinois**

For more data on these items, use post cards p 169. Identify your request with item number.

### Small Size Drills

**269** • New method of manufacturing drills in the 0.15-mm to 1/16-in. range produces consistently accurate cutting points. Grinding flutes of drills from solid heat-treated blanks results in uniform, close tolerance tools that are not subject to distortion. Grinding of points during fluting operation guarantees proper relationship of cutting angle to flutes and axis of drill.

**Whitman & Barnes, Div of United Drill & Tool Corp, Plymouth, Mich.**

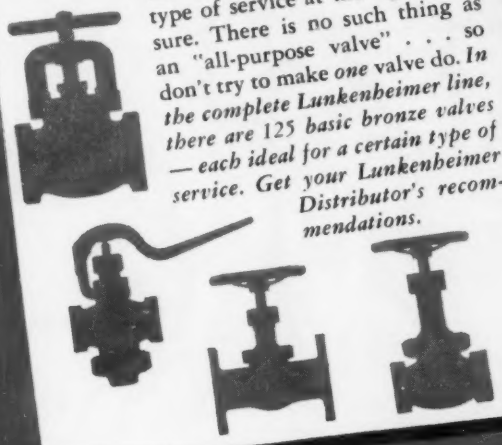
### Building Material

**270** • New building material made of wood fibers bonded together with inorganic

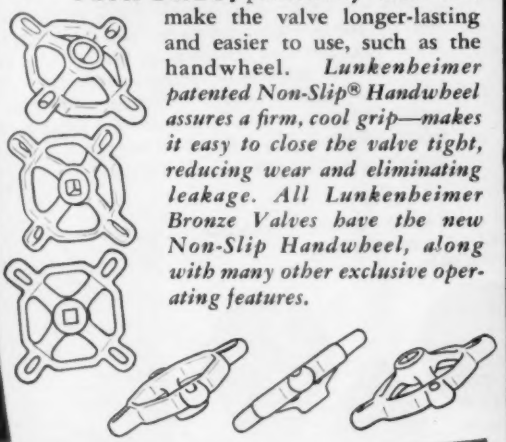
WHAT TO LOOK FOR

# when you buy a Bronze Valve

**1 LOOK FOR DESIGN.** Use the right valve for the right type of service at the right pressure. There is no such thing as an "all-purpose valve" . . . so don't try to make *one* valve do. *In the complete Lunkenheimer line, there are 125 basic bronze valves — each ideal for a certain type of service. Get your Lunkenheimer Distributor's recommendations.*



**2 LOOK FOR OPERATING FEATURES,** particularly those that make the valve longer-lasting and easier to use, such as the handwheel. *Lunkenheimer patented Non-Slip® Handwheel assures a firm, cool grip—makes it easy to close the valve tight, reducing wear and eliminating leakage. All Lunkenheimer Bronze Valves have the new Non-Slip Handwheel, along with many other exclusive operating features.*



**3 LOOK FOR A LONG-WEARING STEM,** since stem-thread wear is one of the most common causes of valve failure. *Lunkenheimer Bronze Valves have Stemalloy® Stems — an exclusive silicon-bronze alloy which completely eliminates stem-thread failure. Not one of the millions of Stemalloy Stems now in service has ever been returned because of thread wear.*

**4 LOOK FOR CLOSE-GRAINED BRONZE,** the mark of valve quality. Dense bronze not only increases the valve's strength, but makes it much more resistant to corrosion. *Lunkenheimer Bronze Valves are made of original Lunkenheimer alloys recognized by metallurgists as the highest-grade valve bronzes ever developed.*

*Remember—The Price Of A Lunkenheimer Valve Gets Smaller And Smaller And Smaller With Each Passing Year Of Dependable Service*

**ALL POPULAR SIZES** of Lunkenheimer Bronze Valves are maintained in stock for prompt delivery. Write for new Circulars 534, 582, and 574 describing typical designs. The Lunkenheimer Co., Box 360A, Cincinnati 14, Ohio.

LUNKENHEIMER QUALITY

**BRONZE • IRON • STEEL**

# LUNKENHEIMER®

THE ONE *Great* NAME IN VALVES

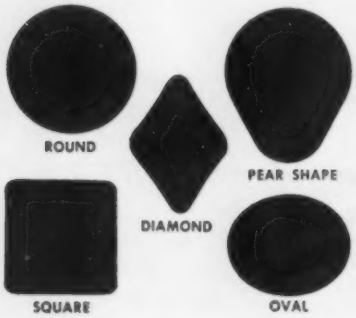
L-154-15

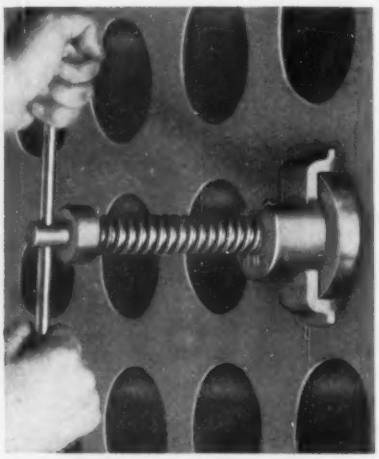
# ROTO *Hand Hole* Seat Scraper

## *Eliminates Dirty, Tedious Work*

**Here is a simple, hand-operated tool for cleaning inside caps on boilers that will pay for itself many times over. This tool is equipped with retractable knives mounted on a revolving spindle having a bearing within a substantial yoke. An adjustable spring automatically maintains tension on the knives, sufficient to remove all foreign matter but not enough to cut the metal. A few turns to the right, and the job is done. A half turn to the left releases the tool. Try a Roto Seat Scraper and you'll wonder how you ever got along without one.**

**These are some of the hand hole shapes cleaned with a Roto Seat Scraper. Various sizes available.**



*Illustrating ease of operation of Roto Hand-hole Seat Scraper.*

*Roto Hand-hole Seat Scraper for B & W Boiler.*

## What Users Say—

**It did a fine job. Completed the work in 80% less time.**
***(Engineer, Chemical Plant)***

**Roto Seat Scraper has paid for itself many times over on our Keeler Boiler.**
***(Supt., Public Utility)***

**One man cleaned inside cap seats on boiler header in 4 hours. Formerly took 2 men 3 days.**
***(Pennsylvania Manufacturer)***

**We also make a Reseating Machine for cleaning outside caps to assure a smooth, true fit. Send for details.**

***SEND FOR BULLETIN***

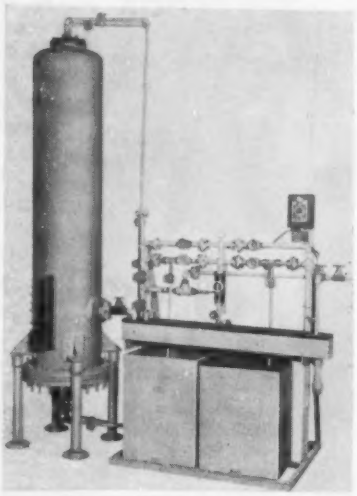
**ELLIOTT COMPANY-ROTO DIVISION**
**153 Sussex Avenue** **Newark 1, N. J.**


# More EQUIPMENT NEWS

*Begins on page 160*

cement possesses high insulating value, excellent acoustical properties and has UL approval for incombustibility. Claimed to be structurally stronger in many ways than concrete, material can be sawed, chopped or drilled. Manufacturer recommends its use as wall core in metal structures.

**Tectum Corp, 105 S 6th St, Newark, Ohio**

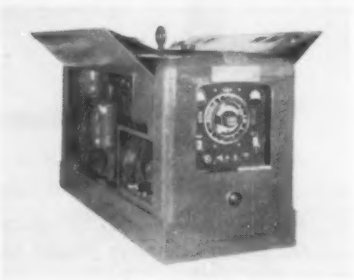


### Water Demineralizers

**226** • New line of mixed-bed water demineralizers features latest engineering developments in ion-exchange process of water purification and includes improved system for regeneration of purifying resins after they have become exhausted. Effective ion removal results in effluent water of very high resistance, often up to 20-million ohms per cc. Literature and engineering recommendations available from manufacturer.

**Barnstead Still & Sterilizer Co, Lanesville Terrace, Forest Hills, Boston 31, Massachusetts**

For more data on these items, use post cards p 169. Identify your request with item number.



### Arc Welder

**207** • Diesel-driven arc-welder of 300-a capacity is especially suitable for locations where electric power is lacking and minimum cost is desired. Exclusive *Multi-Range Dual Control* permits operator to make fine v-a adjustments right at the work. Full details available from manufacturer.

**Hobart Bros Co, Dept DW, Hobart Sq, Troy, Ohio**

## *Get this*
# BIG, NEW BOOKLET ON
## *Engineered . . . ℞ . . . Prescribed*
# REFRACTORIES

### *A basic guide to more efficiency and economy in your boiler settings*

Compiled to help you solve refractory problems affecting boiler operations, this new Norton booklet is now ready for immediate mailing to your plant.

Here you'll find 32 pages of easy-to-read, money-saving facts, together with explanatory charts, diagrams and photographs describing the many uses and advantages of Norton CRYSTOLON* refractories for heat and power applications.

### *The right ℞ for every boiler need*

This booklet gives you full information on the best protection for water tubes; for the construction of air-cooled and solid walls; on laying bricks and making general repairs; on the correct refractories to use for every type of boiler. The properties of various refractories are thoroughly described and there are handy quick-figuring charts for temperature conversion, boiler efficiency, etc.

Remember, these refractories are *engineered and prescribed* by Norton to save you time and money in your heat and power requirements. This booklet tells you how. Send for your copy today. NORTON COMPANY, 441 New Bond Street, Worcester 6, Mass. *Canadian Representative:* A. P. Green Fire Brick Co., Ltd., Toronto 5, Ontario.

*Trade Mark Reg. U. S. Pat. Off. and Foreign Countries

**NORTON REFRACTORIES**

*Engineered . . . ℞ . . . Prescribed*

*Making better products . . . to make other products better*

this Bulletin...

Gives you

THE "INSIDE STORY" ON THE GREATEST PROGRESS IN SAFETY VALVES FOR OVER 50 YEARS!

*Yes,* IT'S ALL ABOUT THE NEW

LONERGAN
UNI-LINE
41-W-200 SERIES

*NO OTHER VALVE LIKE IT*

**The UNI-LINE features:**

- a *Much Higher capacity* per size, than any other safety valve.
- a free-acting, self-aligning disc.
- a *"floating" guide* (readily adjustable for control) . . . assists in opening and closing action, as well as affording an additional self-aligning feature.
- a Disc and Disc holder of *forged copper alloy*, not castings.

For full details about the money-saving, maintenance-free advantages of these "features", plus valve data and specifications, write for your free copy of this new UNI-LINE 41-W-200 Series Bulletin.

Lonergan
J. E. LONERGAN COMPANY
Established 1872
RACE & 2nd STREETS • PHILA. 6, PA.

# More EQUIPMENT NEWS

Begins on page 160

### Safety Solvent

**251** • Highly effective, quick-drying safety solvent cleans electrical equipment such as wiring, fuses, motors, switches, etc. Specially formulated to replace cabon tetrachloride in all cleaning operations, *Turco-Solv* combines least toxic solvents available consistent with safety. Material is non-corrosive and is safe for use on all metal and wood surfaces as well as well-bonded paint. It has a Tag Closed Cup flash point of over 200 F and will not leave flammable vapors or residues upon evaporation. Complete details available from manufacturer.

**Turco Products, Inc, 6315 S Central Ave, Los Angeles 1, Calif.**

### Metal-Ceramic Thermocouple

**246** • New thermocouple protection tube combines thermal conductivity and shock resistance of metal with oxidation and deformation resistance of ceramics. Unit has wall thickness of only ⅛ in., so time lags in temperature response are drastically reduced. Material itself has thermal conductivity about the same as cast iron. Available in lengths of 12, 18, and 24 in., the metal-ceramic well can also be supplied in a complete thermocouple assembly. Complete physical properties and specs are available in manufacturer's bulletin P1261.

**Bristol Co, Waterbury 20, Conn.**

### Zinc Anodes

**243** • New line of seven zinc anodes meets requirements of corrosion engineers for specific types of underground or underwater installations. The new anode shapes, cast of special high-grade zinc, meet most known applications, but manufacturer is willing to work with corrosion engineers in development of other special designs.

**New Jersey Zinc Co, 160 Front St, New York 7, N. Y.**

### Variable Speed Drives

**271** • Positive, infinitely variable speed drives are now available in two new types for 20 to 25-hp applications. Units are fully enclosed and constructed entirely of metal. All moving parts are splash lubricated from common reservoir, and are unaffected by temperature, humidity, abrasive dust or explosive vapors. Folder 2374 available on request.

**Link-Belt Co, 307 N Michigan Ave, Chicago 1, Illinois**

### Control Valves

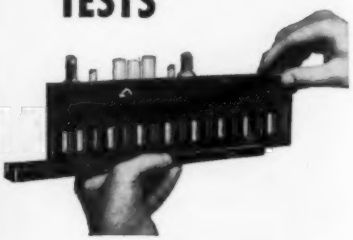
**272** • New line of high-capacity automatic control valves adapts itself to almost all liquid and vapor control services by a simple change in external actuating equipment, manufacturer claims. Valves have angle body design and are available in 2, 3, 4 and 6-in. sizes for pressures ranging up to 150 psi. Additional information and price list available from manufacturer.

**Controlled Flow Valve Co, 805 Baltimore Ave, Kansas City, Mo.**

"couldn't do without my

TAYLOR COMPARATOR

for BOILER WATER pH, PHOSPHATE TESTS"



That's what power plant engineers say in plants all over the country . . . because Taylor Comparators give you fast, easy determination of boiler water pH and phosphate, as well as complete water analysis. And you can make these determinations right in the boiler room! No need to carry solution samples back to the lab since your Taylor Set is lightweight, small, no trouble to carry with you.

EASY TO USE

Taylor Comparators use the familiar colorimetric method of comparison, but without the need for fragile, single Nessler tubes. All color standards for a single determination are housed in a sturdy plastic slide. Many different slides may be used on the same base.

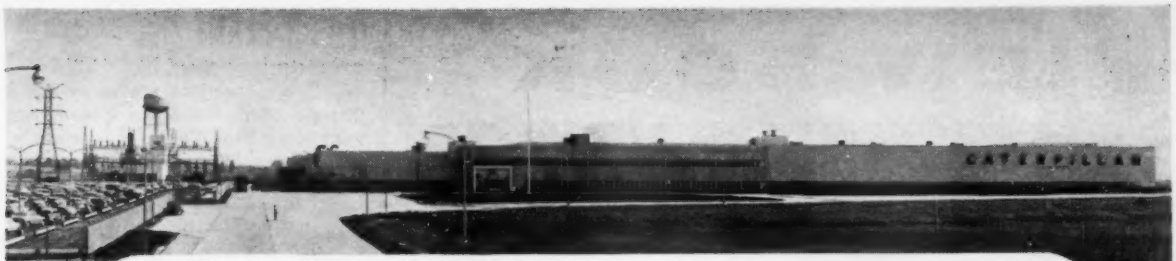
ACCURATE

There's no chance of mechanical inaccuracy because all Taylor Liquid Color Standards carry an unlimited guarantee against fading!

GET THE FULL STORY . . .

**from your lab supply dealer . . . or write for free book, "Modern pH and Chlorine Control". Gives theory and application of pH and Chlorine control, illustrates and describes full Taylor line.**

W. A. TAYLOR AND CO.
YORK RD. & STEVENSON LANE • BALTO. 4, MD.




# NEW PLANTS LIKE CATERPILLAR'S BURN COAL THE MODERN WAY!

**Mr. R. H. Bachman,**
**Plant Maintenance Engineer,**
**Caterpillar Tractor Co., says:**

"Our new plant pictured above was recently completed at Joliet, Illinois. A completely up-to-date coal installation was chosen to handle the heat and process steam requirements. To the right is a picture of the firing aisle showing how the boilers are fed by dust-tight chutes from overhead bunkers. This modern equipment makes coal as clean, convenient, and efficient as a fuel can be! The boilers are rated at 80,000 lbs. of steam per hour, but have handled loads as low as 3,000 lbs. per hour without difficulty."

**For big savings, build for COAL!** That's a good rule to follow whether you've got a new plant under construction or an older plant being modernized.

Up-to-date coal-burning equipment can give you more steam per dollar . . . modern coal- and ash-handling systems can cut labor costs to a minimum. In addition, coal is the only fuel with virtually inexhaustible reserves. And to mine this coal, to better prepare it for customers' special needs, America has the world's most productive coal industry. Thus, coal users get a double advantage—*dependable supply of an even better product, at relatively more stable prices.*

For heat, power, process steam—coal is your best bet! Ask a consulting engineer. He'll show you how to cut both fuel and operating costs by burning coal in a modern plant designed to meet your specific needs.

**If you operate a steam plant, you can't afford to ignore these facts!**

- **COAL** in most places is today's lowest-cost fuel.
- **COAL** resources in America are adequate for all needs—*for hundreds of years to come.*
- **COAL** production in the U.S.A. is highly mechanized and by far the most efficient in the world.
- **COAL** prices will therefore remain the most stable of all fuels.
- **COAL** is the safest fuel to store and use.
- **COAL** is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

**BITUMINOUS COAL INSTITUTE**
A Department of National Coal Association, Washington, D. C.

*FOR HIGH EFFICIENCY FOR LOW COST*

# *YOU CAN COUNT ON COAL!*

# NEW BOOK TELLS HOW TO

√RECLAIM CARRYOVER FROM VESSELS

√ELIMINATE PIPELINE ENTRAINMENT

End Dirt and Moisture Problems the Hi-eF Way
ANDERSON Hi-eF PURIFIERS
for LIVE STEAM EXHAUST STEAM COMPRESSED AIR VAPORS and GASES

INTERNAL Hi-eF PURIFIER

● Towers, columns, stills, evaporators can be operated at greater efficiency and capacity by following the practices recommended in this booklet. You'll find data on how to prevent valuable solids from leaving process vessels. This booklet also tells how to avoid contamination of distillate and other products with foreign entrainment; and also how to stop contamination of processes with guck and solids.

● Pipeline entrainment such as dirt, moisture, and guck in steam, vapor, gas and air lines lower the efficiency of your plant process and equipment. Keep this dangerous material out of your piping systems effectively and inexpensively by following the suggestions outlined in this brochure. This booklet also describes Hi-eF Purifiers, noted for their savings and maintenance-free operation in removing or recovering impurities.

*Write for your free copy TODAY!*

THE V. D. ANDERSON COMPANY
1934 West 96th Street • Cleveland 2, Ohio

Gentlemen:
Please send free copy of Purifier Bulletin 700.

Name .....

Address .....

City ..... State .....

ANDERSON Hi-eF PURIFIERS

ANDERSON


# HYDRO PLANT

Continued from page 89

ing. Bus connections are so arranged that generators No. 1 and 2 connect to transformer bank No. 1 and 2, as in Fig. 6, and generators No. 2 and 3 connect to transformer bank No. 3 and 4, not shown. These transformers are being built by the English Electric Co of Canada and Ferranti Ltd. They are electrically interchangeable and have a guarantee efficiency of 99.25, or better, from one half to over full load.

**300-Kv Cables.** From each transformer bank, three single-conductor cables run 2000 ft through a tunnel to a duplicate bus in the 300-kv outdoor switchyard. Each cable conductor is 1 in. in diameter and stranded around a hollow core filled with insulating oil under a pressure of 40 psi. Over the conductor is a graded-paper insulation, 1 in. thick, impregnated with oil, over which is a metal sheath, 3.75 in. in outside diameter. Each group of three cables transmits the output of two 106,000-kw generators and connects to the high-voltage buses through an air-blast circuit breaker with 6,000,000-kva-rupturing capacity.

**Power-Transmission Lines.** From the switchyard, power is transmitted 50 miles over aluminum transmission lines with the largest conductors ever fabricated, 2.3 in. in diameter. These lines run through a narrow mountain pass that rises to an altitude of over one mile and down to Kitimat, at sea level. Here the world's largest aluminum refinery is being built. It will ultimately have an annual capacity of 500,000 tons.

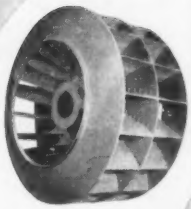
Since this plant is in virgin country a city will be built to accommodate the plant's personnel and many others. Eventually its population may be 50,000. In addition, a seaport is being built. Ships from many lands will bring in bauxite, cryolite, fluorspar and other raw materials for aluminum-ingot production. The port will also distribute the refined product to all parts of the world.

**Acknowledgments.** This great project is a tribute to the genius of McNeely DuBose, vice-president; A W Whitaker Jr, vice-president and general manager; W L Pugh, chief engineer—all of Alcan. P E Radley is project manager. Engineers for Alcan on power development and transmission facilities are British Columbia International Engineering Co Ltd, a subsidiary of International Engineering Co, San Francisco, Calif., under the direction of W G Huber, general manager, and G E Crippen, chief engineer. Morrison-Knudsen Co of Canada, Ltd, a subsidiary of Morrison-Knudsen Co, Boise, Idaho, of which C P Dunn is vice-president, is the contractor in charge of construction of power development and transmission facilities.

# NOT A WEAK LINK

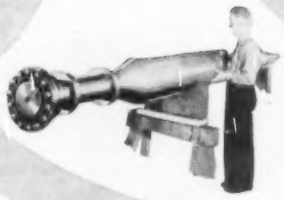
## IN THE CONSTRUCTION OF "BUFFALO" INDUCED DRAFT FANS

rotor



housing

bearings



shaft

So much depends on the continued operation of your draft fans that it pays to be sure that there are no weak links in the construction. Housings, wheels, blades, bearings and shafts — *all* must be up to the job, or the fan as a whole cannot function.

Every part of a "Buffalo" Induced Draft Fan is built up to stand known conditions of wear, heat and erosion. The shaft is turned from a solid piece of forged steel with extra large thrust collars. Bearings are heavy-duty, self-aligning and water-cooled. Housings are heavy-gauge steel, hot-riveted, with removable scroll liners where erosion is most severe. Blades are built up with welded-on wearing strips. In short, every "link" in the construction of these fans is designed for maximum long life in this punishing fan job.

It is all part of the "Q" Factor* which assures you of best results whenever you buy "Buffalo". Write now for Engineering Bulletin 3750.

**BUFFALO FORGE COMPANY**

488 BROADWAY BUFFALO, N. Y.

*PUBLISHERS OF "FAN ENGINEERING" HANDBOOK*

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

"Buffalo" DRAFT FANS

** The "Q" Factor — The built-in quality which provides trouble-free satisfaction and long life.*

# FOR VALVES IN CORROSIVE SERVICE

Industrial plants large and small have long been looking for a permanent acid packing for those "hard-to-get-at" valves.

These valve stems must be packed and made tight at all times. A drip from a leaky valve is dangerous to personnel. These acid valves require 1/8", 3/16", 1/4", 5/16" or 3/8" square packing. Up to now braided blue asbestos packing has been considered best and cheapest (60-day life). Today the whole world of packing has been changed by the material "Teflon". Braided yarn packing made of Teflon is replacing all forms of braided packing for acid service because it lasts as long as the valve itself. Practically no acid, diluted or concentrated, hot or cold, has any affect on the packing. (Many records of two-years' service or more have been reported). This is highly important to all Power Plant Engineers and Operators.

"JOHN CRANE" Style 704 is available in handy coil or spool form in a full range of sizes. A stock of "JOHN CRANE" Braided Teflon Packing in your storeroom may be a life saver for you.

Teflon is recommended on chemicals at any pressure with temperatures ranging from −100°F. to +500°F.

Many Power Plant Engineers prefer "JOHN CRANE" Style 704 Braided Teflon Packings for their service. For the best in mechanical packings fabricated from braided Teflon, contact Crane Packing Company. *Send for this Teflon Technical Bulletin.* Write 1830 Cuyler Avenue, Chicago 13, Illinois.

*Du Pont's trademark for tetrafluoroethylene resin.

JOHN CRANE CRANE PACKING COMPANY


## MARMADUKE

Continued from page 148

in so long it sounded like a constant broadside from a man-of-war. But everything was neglected for that aquarium.

"By the time we arrived in Pernambuco, the First and his gang had built the tank next to the hotwell. It was about six feet long, four feet wide and five feet high, with a ship's port-hole in the side, same as our hotwell. Fact is, you couldn't tell the two apart. The inside was lined with feedwater-strainer toweling. A sheet-iron hinged cover was for keeping the fish from spilling out during a heavy sea. A dozen electric lights inside watertight vapor-globes lighted up the tank.

"Temperature was maintained with a small steam heating coil, wrapped with toweling to protect the fish. Steam was regulated with a one-quarter inch valve, while the coil's other end dripped into the bilges.

"Instead of making repairs in Pernambuco, the First and his gang were busy bringing the fish aboard in containers. It was a ticklish job and they handled them with kid gloves.

"My boys were sweating in the fireroom as they turbined boilers and built brick walls. But I knew it didn't mean much to save fuel in the boiler room when it was wasted in that broken down engine room.

"The Chief and First made up log sheets for the aquarium. Temperature, time of feeding, number of dead fish, tank cleaning and every other detail was logged each hour. If they gave the ship's machinery half that attention, we'd had a great ship.

"After three weeks along the East coast of South America, we got orders to shove off for Boston before going over to Antwerp. By the time we hit the Caribean Sea the angle fish had spawned and the aquarium was filled with thousands of tiny fish about a quarter of an inch long. Looking through the porthole into that lit-up tank was like looking out into the ocean. I've stood a lot of watches in all kinds of engine rooms, but that's the only one that made me feel like I was in a submarine.

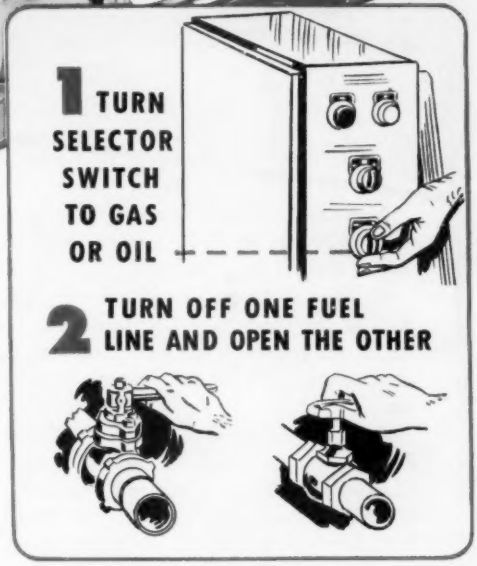
"Along the coast of Florida we got a wireless to pull into Philadelphia. That burned up the Chief and First because they wanted to get rid of those fish and collect their money.

"Tying up in Philly, who should be waiting on the dock but the Port Engineer from Boston. When the Skipper spied him, he quickly tipped off the Chief, who in turn wised up the First down below. The First got panicky and got his oilers to start bailing out the fish and hide them—anywhere.

"One oiler dumped a bucket full into

# NOW... interchange Gas and Oil firing in *10 seconds*

Modern Cleaver-Brooks Model LR Steam Boiler Equipped with Exclusive Cleaver-Brooks "10-second conversion" Combination GAS and/or OIL Burner




## TWO, simple motions eliminate time-consuming change-over

Now you can use oil or gas at the flick of a switch! This exclusive new Cleaver-Brooks development permits changeover from oil to gas or vice versa in only 10 seconds.

That's because the Cleaver-Brooks Combination Gas and/or Oil Fired Boiler operates on gas *with the oil burner in place*. Simply flipping a selector switch on the control panel to either gas *or* oil sets the proper circuit in action. Turning the convenient fuel supply valves completes the entire changeover — and in 10 seconds or less!

To gas users in all parts of the country — and in particular areas where local requirements demand immediate changeover — this exceptional fuel flexibility can be an important factor in determining your overall operating economy.

Ten-second conversion, like 4-pass construction, self-contained design, guaranteed 80% efficiency, is another "plus" feature pioneered by Cleaver-Brooks. It demonstrates Cleaver-Brooks' continuing effort to bring steam users even greater flexibility and reduced operating costs.

If you are considering simplifying your present boiler plant, remember Cleaver-Brooks Combination GAS and/or OIL Fired Boilers. Sizes 15 to 500 h.p. — 15 to 250 p.s.i. Write for complete facts.

**Cleaver-Brooks**

**Originators of the Self-Contained Steam Boiler**

CLEAVER-BROOKS COMPANY

Dept. B, 300 E. Keefe Ave., Milwaukee 12, Wis., U.S.A.
Cable Address: Clebro-Milwaukeewis

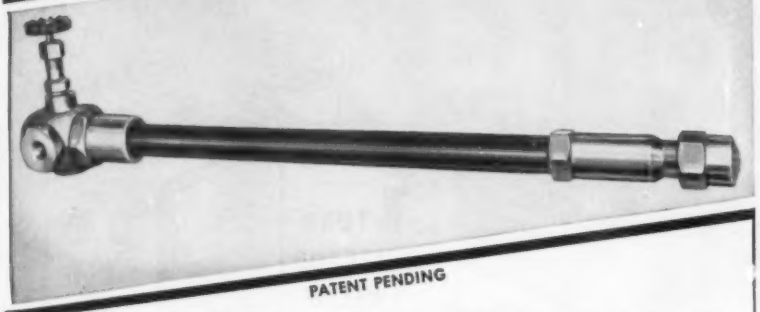
Builders of Equipment for the Generation and Utilization of Heat • Steam Boilers • Oil and Bitumen Tank-Car Heaters • Distillation Equipment • Oil and Gas-Fired Conversion Burners

# NATIONAL AIROIL

## OIL BURNERS

of the steam and mechanical types now combined into

## DUAL STAGE BURNERS



PATENT PENDING

Now, at last, the inherent advantages of *both* systems of fuel oil atomization are *profitably* yours . . . within the one, new NATIONAL AIROIL Dual Stage Burner.

41 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . . and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H.R.T., Scotch Marine and Water Tube Boilers; etc.

Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel from No. 2 to No. 6, with a ready capacity of 80 to 300 g.p.h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get detailed description, illustration, and specifications in NATIONAL AIROIL Bulletin 25.

- OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
- STEAM ATOMIZING OIL BURNERS
- SLUDGE BURNERS, Steam Atomizing
- MOTOR-DRIVEN ROTARY OIL BURNERS
- MECHANICAL PRESSURE ATOMIZING OIL BURNERS
- DUAL STAGE, Combining Steam and Mechanical Atomization
- LOW AIR PRESSURE OIL BURNERS
- AUTOMATIC OIL BURNERS, for small process furnaces and heating plants
- GAS BURNERS
- COMBINATION GAS & OIL BURNERS
- FUEL OIL PUMPING and HEATING UNITS
- FURNACE RELIEF DOORS
- OBSERVATION PORTS
- SPECIAL REFRACTORY SHAPES

**NATIONAL AIROIL BURNER CO., INC.**

1250 EAST SEDGLEY AVE., PHILADELPHIA 34, PA.
Southwestern Division: 2512 South Boulevard, Houston 6, Texas

INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT


## MARMADUKE

Continued from page 198

the galley's large coffee urn that had just been filled with clean water. Another oiler dumped a load into the soup kettle. The First was madly inspecting empty oil drums all this time. But they were too dirty for those fish.

"While this confusion was going on, the Port Engineer came aboard and headed for the engine room without stopping in at the Chief's quarters. The First and his stooges saw him coming down the engine room ladder so they ducked into the shaft alley.

"When the Port Engineer got to the hotwell, he stopped dead in his tracks. There before him was not one, but what looked like TWO hotwells. And one of them was alive with FISH.

"For a second the old boy stood there like a statue with his eyes glued on that porthole. Then he slowly came too and started scratching his head. Finally he got up enough steam to walk about the engine room. But every now and then he'd stop, look back at that aquarium, shake his head and mumble something.

"The engine room bulkheads were dirty, glands and joints were leaking and the brass and brightwork hadn't been polished in months. He could easily see that the aquarium had cost the shipping line plenty of money. Finally, he came into the fire room.

"I was up on the grating cutting out two of my boilers. But I saw the port engineer looking at the newly painted bulkheads, and the shined brass and brightwork.

" 'I came down here for a suprise inspection when I heard you were pulling into Philly,' he told me after I hit the floorplates. 'I'm real pleased with your department. But of four ships in this class, this one burns more coal and has more breakdown than the others. Now I see why.'

" 'Keep this under your hat,' he said confidentially, 'Leaving Boston, you're going chief and I'm greasing the gangplank for the Chief and the First.' Just then the Chief came into the fireroom and acted surprised to see him. I got back to my boilers, but I could tell the port engineer was building up a head of steam.

"I don't know what went on between those two, but when I entered the officer's mess at noon, the Chief and First were mighty jittery. The port engineer wasn't saying anything, but that silent treatment was a lot more effective than a lot of noise—just then.

"There was no talking all through the meal. The messroom was electric with tension. Then as the port engineer got to ballasting his tanks with coffee, he suddenly started coughing violently, as if something had plugged his intake.

MAINTENANCE MEN PREFER
O-B GATE VALVES FOR . . .

# Easy take-down
# Quick re-assembly
## in close quarters

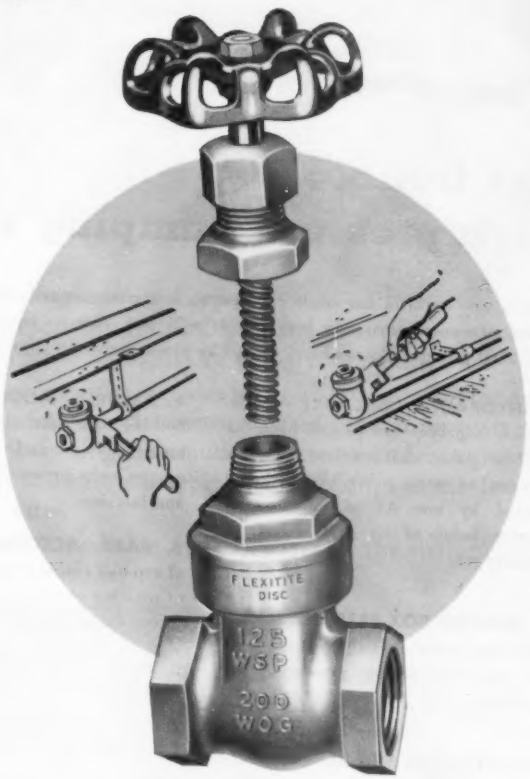
● O-B gate valves "break" conveniently and easily at the center joint. Stem, handwheel, packing nut and stuffing box come off as a unit. The Flexitite Disc® remains in the body. It stays in position for the stem to be re-inserted.

This easy take-down feature of non-rising stem gates simplifies installation in locations where space is limited. With most of the trimmings removed, there's more room for threading the valve body to pipe ends. Then when the body is in position, the valve can be re-assembled in a few seconds.

It's features like the easy take-down that make O-B gates preferred for industrial maintenance. They're available in sizes up to three inches, and for up to 200 pounds working steam pressure.

O-B bronze valves have been serving in industry for more than 60 years. Call your local Ohio Brass distributor for valves convenient to install and dependable in service.

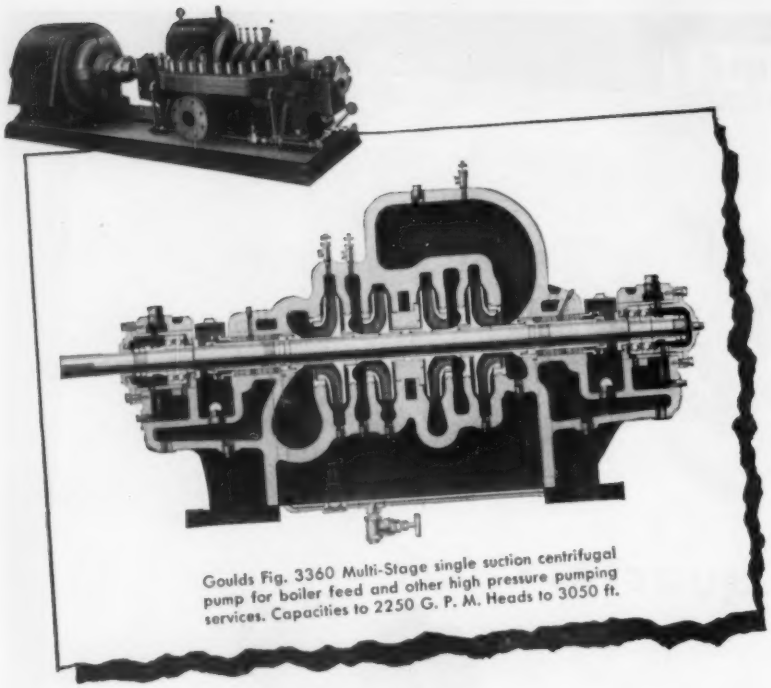
Ohio Brass Company
Mansfield, Ohio




Ohio Brass Valves

BRONZE GLOBES, ANGLES, GATES AND CHECKS
FOR INDUSTRIAL SERVICE

4443-V



Goulds Fig. 3360 Multi-Stage single suction centrifugal pump for boiler feed and other high pressure pumping services. Capacities to 2250 G. P. M. Heads to 3050 ft.

# Get trouble-free high pressure pumping service

**If you are looking for high efficiency, low maintenance boiler feed and other pressure pumping services, it will pay you to investigate Goulds Fig. 3360 pumps. Power Engineers like them because they provide:**

**1. HYDRAULIC BALANCE**—Single suction impellers are placed back to back in pairs with suction openings opposed to each other. End thrust created by one set of impellers is counter balanced by end thrust of opposite set.

**2. STUFFING BOX PRESSURE RELIEF**—Stuffing boxes at both ends of pump have an inner sealing pressure relief chamber.

**3. MAINTAINED EFFICIENCY—MINIMUM INTERNAL LEAKAGE**—Leakage from high pressure to low pressure side is minimized by long center casing bushing with liner.

**4. ASSURED ALIGNMENT**—Bearing housings are cast as integral part of lower half casing. Double tongue and groove locks prevent rotation of rings and bushings.

**5. EASY ACCESSIBILITY**—Removal of top half casing permits easy removal of rotating element without disturbing piping connections.

**6. INTERCHANGEABILITY OF PARTS**—Close machining and rigid inspection guarantee interchangeability of parts. Save on inventory and down time.

**For detailed description, specifications and dimensions, contact your nearby Goulds representative or write for Bulletin 722.5.**

MEMBER HYDRAULIC INSTITUTE U.S.A.

Goulds PUMPS INC. Seneca Falls New York

## MARMADUKE

Continued from page 200

Just as he was about to blow a cylinder head, he coughed up a glob into his hand. Then his eyes opened wide and he turned beet red around the gills.

"'FISH,' he yelled, jumping up from the table and slamming his cup against the steel deck.

"'Not only did you fish merchants turn the engine room into an aquarium, but you even got those slimy creatures into the ship's food. YOU AND THE FIRST ARE FIRED!' he roared at the startled Chief.

"'I was going to wait until Boston,' he continued, 'but you two can pack your bags RIGHT NOW—and you're lucky if I don't have your licenses suspended.'"

Marmaduke stopped talking and shook a warning finger at me. "If some engineers used half as much voltage improving their plant as they waste on trying to make a quick dollar, they'd really cut their fuel bills."

As I started backing quickly down the creaky stairs, he let go another broadside, "A power engineer's gotta choose between being a merchant or an engineer—he can't be both." —*SME*

## SUPERPRESSURE PUMPS

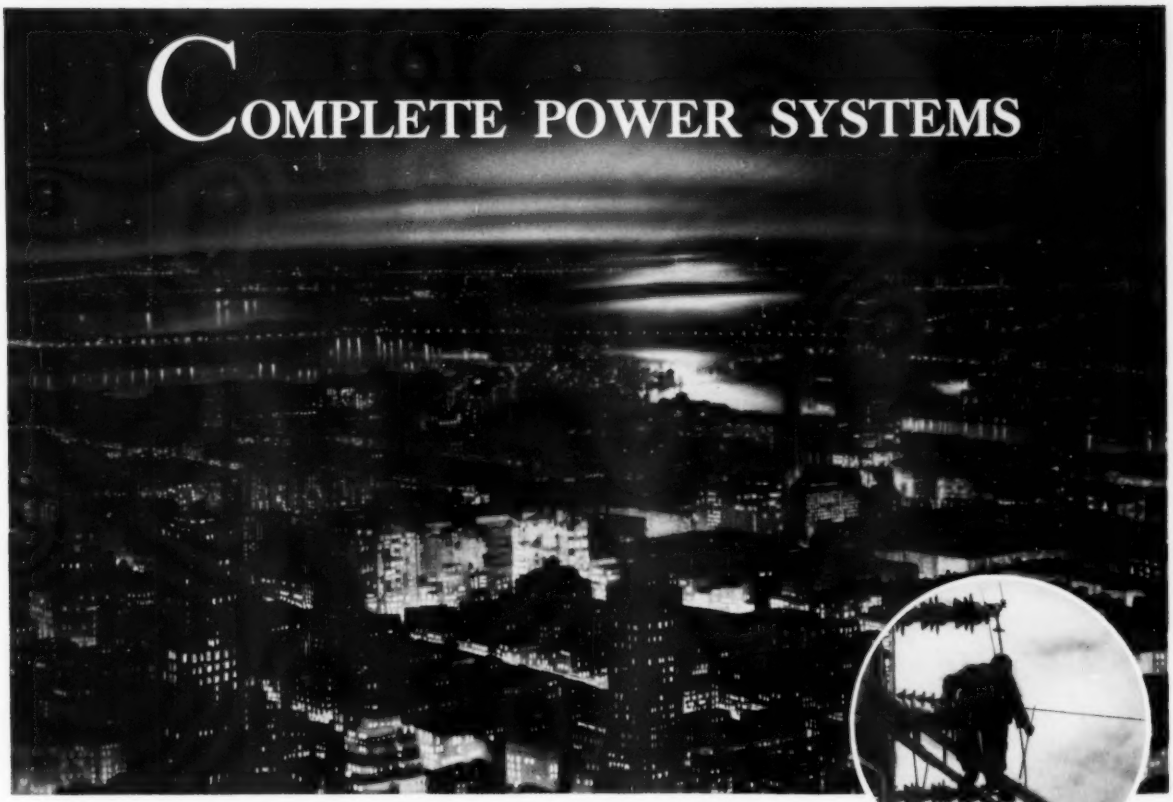
Continued from page 84

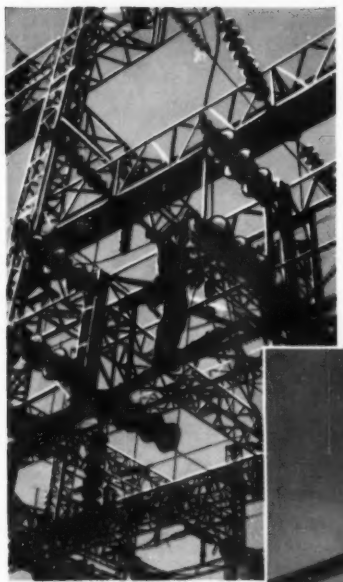
speed when operating on the system-head curve. Also shown is the power input to the hydraulic coupling, following the relationship given above.

**At present,** power-plant designers are almost evenly split on the question of variable speed. However, with the growth of operating pressures, the use of variable-speed drives will probably increase. The simple reason is that the savings (tangible and intangible) mount with increased pressures while the cost per horsepower of variable-speed drives decreases appreciably with size. As a matter of fact, it is almost a certainty that when feed pumps are selected for steam plants operating above the critical pressure, they will of necessity use variable speed. This conclusion is reached partly from an analysis of the savings to be made and partly from the absurdity of designing both the pumps and system for any pressure higher than that required at full capacity.

For instance, with a design discharge pressure of 5500 psi (at maximum temperature), a constant-speed pump would develop up to 7500 psi at light loads when handling the correspondingly colder feedwater. The pump would have to be designed to withstand 7500 psi and so would the rest of the system subject to discharge pressure. Variable-

# COMPLETE POWER SYSTEMS





Stone & Webster Engineering Corporation has many years' experience in the design and construction of complete power systems to serve industries or entire communities.

The Corporation's service includes the initial planning of the system; forecast of loads; design and construction of generating units; transformer facilities; switching distribution; location and construction of transmission lines and substations; interconnection; and the determination of equitable rates.

This experience is available for any phase of the design and construction of power systems.

*Write or call us for information as to how our experience may be of assistance to you.*

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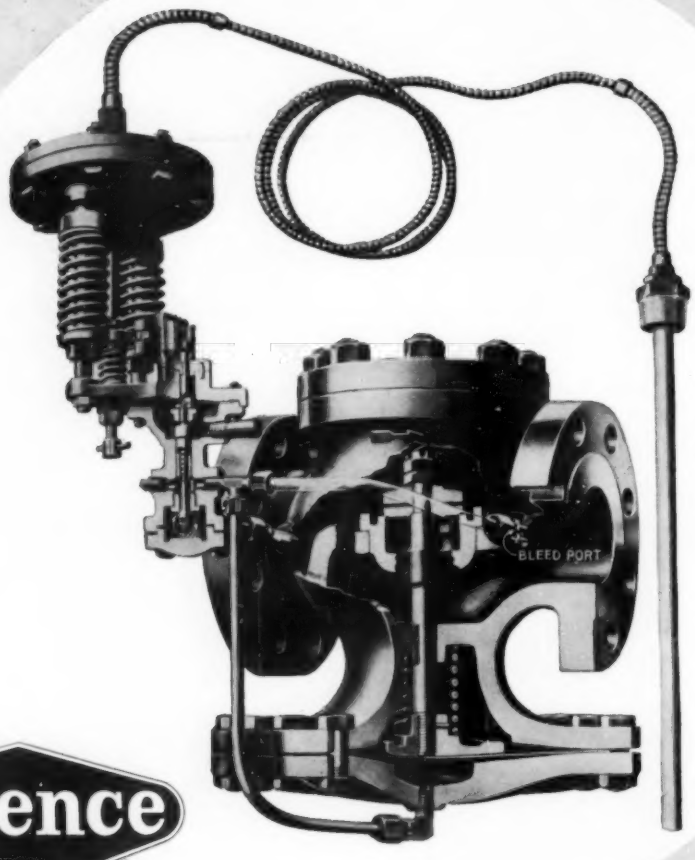
*When equipped with a SECO Metal Seat and Disc on steam service and protected by an approved Strainer, a Spence Regulator is guaranteed to shut tight when the demand for steam ceases.

Expensive steam leaks due to a lack of absolutely tight shutoff are eliminated in Spence Temperature Regulators. Here is why we can make such a guarantee:

First, our temperature regulators are of the single seat design. Seats and discs are made of durable SECO Metal. More than 20 years experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year without requiring expensive repairs or special attention.

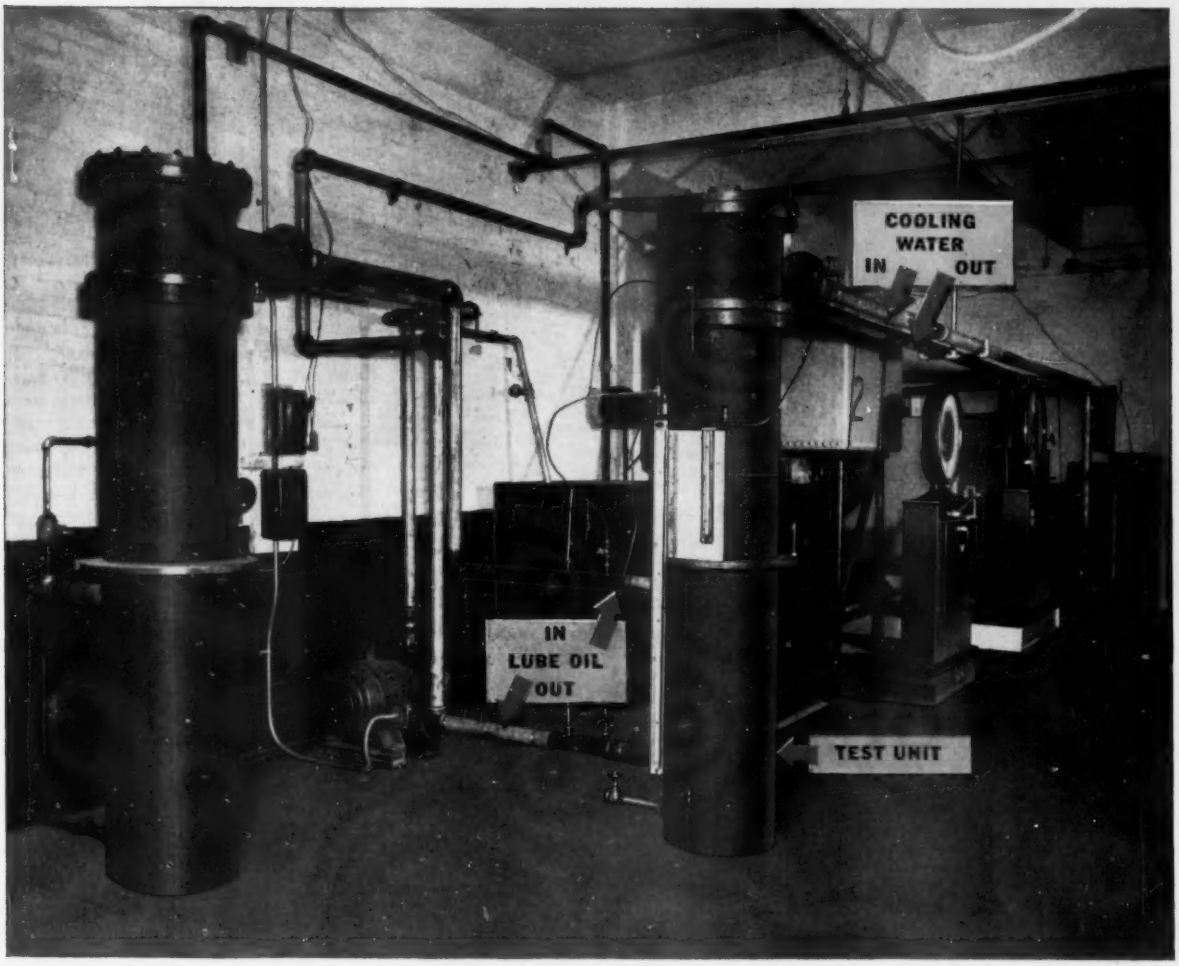
Want more facts? Write for Bulletin T50 giving full details.




SPENCE
TYPE ET150
Temperature
Regulator

Spence

**SPENCE ENGINEERING COMPANY, INC.**
WALDEN, NEW YORK

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Here's a picture with a big story! It shows performance tests being run on one of a large group of ADSCO Lube Oil Coolers.

These tests prove conclusively that everything claimed for these coolers will be performed by them when installed... because the tests are conducted under actual operating conditions in ADSCO's testing laboratories. And here's how the tests are run: Before the lube oil enters cooler at 130 g.p.m., it is brought up to specified temperature of 150F by unit at left and then cooled to 130F by 250 g.p.m. of water entering cooler at 115F and leaving at 119F. Inlet and outlet temperatures are checked by thermometers. Pressure drops for both shell side and tube side are determined by manometers. Oil and water are collected in reservoirs and weighed in tanks on scales to determine capacities.

This testing service puts a pedigree on ADSCO Heat Exchangers. These units, engineered and tailor-made to requirements, come to you exactly rated when tested by ADSCO. The exchanger can be put in the line with complete assurance it will do the job.

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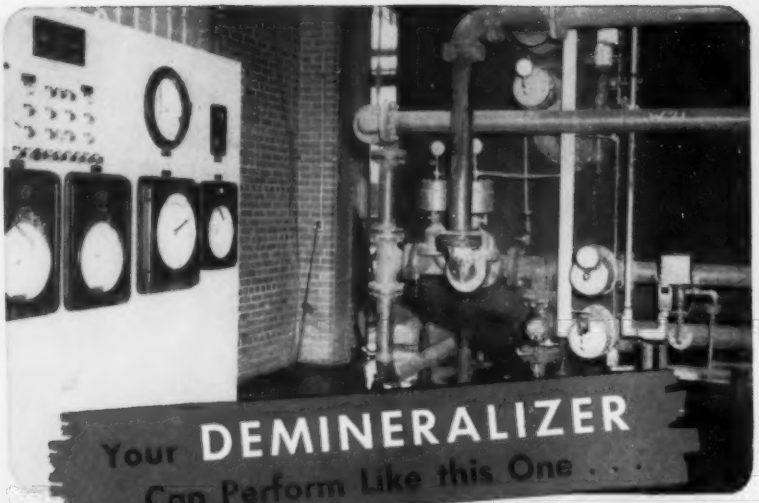


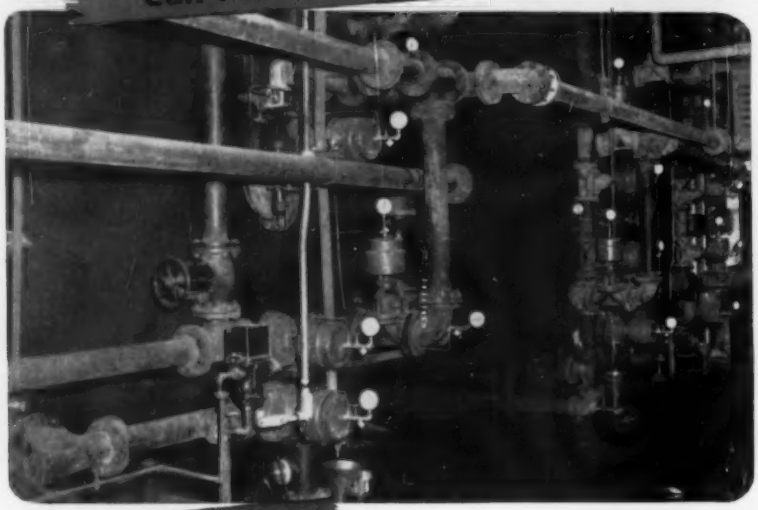

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**PRODUCTS** • *When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.*

# SUPERPRESSURE PUMPS

*Continued from page 202*

speed operation would reduce maximum pressure to exactly 5500 psi. But the last word on obtaining variable-speed operation has not yet been spoken.

### MOTOR-DRIVE SETUPS COMPARED

It is interesting to compare various arrangements for electric-motor drive, on the basis of both constant and variable speeds. In today's fluctuating economy, it is almost meaningless to present cost comparisons in terms of dollars. So comparisons for constant-speed drive combinations in Fig. 4A are on a percentage basis, with 100% representing the price of a 3000-hp 3570-rpm squirrel-cage motor. Likewise, in the variable-speed drive combinations, Fig. 4B, 100% represents the combined price of a 3000-hp 3570-rpm motor and of a 3570-rpm hydraulic coupling.

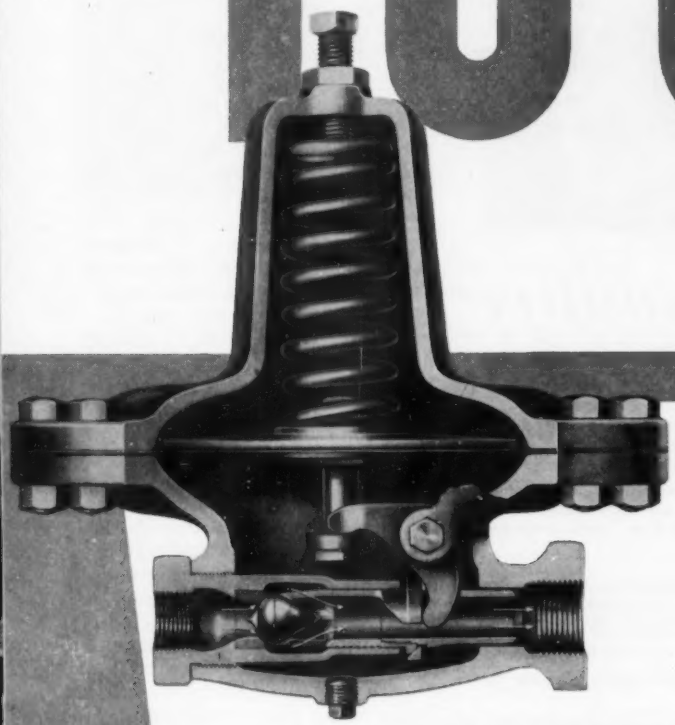
**Turbine Drive.** One of the advantages of higher speeds is the smaller, more compact pump obtainable. However, stepup gears and hydraulic or magnetic variable-speed drives eliminate, to a large extent, the space saving resulting from the smaller pump. Likewise, use of a stepup gear and a variable-speed device materially decreases the over-all pump and drive efficiency.

In the past, motor drive has been used for a number of reasons. Most important of these was the better station economy gained by expanding the steam in the high-efficiency main turbine, even taking into account generator, line and motor losses. With the increase in pump speeds and driver sizes, direct steam-turbine drive becomes more interesting. This is because turbine efficiency increases rapidly with speed. Also, using a turbine eliminates the loss-producing stepup gear and magnetic or hydraulic coupling.

In the range of pressures under discussion, there is no thought of using steam directly from the boiler. Instead, steam for the feed-pump turbine would be taken from an extraction point of the main turbine. Individual considerations of the heat balance will determine whether (1) the turbine will exhaust to the main condenser or (2) a backpressure turbine, exhausting to one of the heaters, will be used.

Note that characteristics of a main steam turbine are such that extraction steam cannot be used for the feed-pump drive at all station loads without imposing on the feed-pump turbine an impossible range of inlet pressures. For example, a 160,000-kw turbine receiving steam at 1800 psi and 1000 F has a first extraction-point pressure of 475 psia at rated output, 150 psia at 50,000 kw and 40 psia at 10,000 kw. As it is not desir-

# TYPE 1000 VALVE



Any product of quality should be dependable when *ordinary* products fail. Sudden pressure fluctuations, dirt, scale and viscous matter prove "fatal" to ordinary pressure reducing valves.

The CASH STANDARD TYPE 1000 VALVE however, is designed to operate with complete dependability under the most difficult and unusual circumstances. Many of these units have been in service over 10 years and have never been taken "out of the line."

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## PRESSURE CONTROL
## *for Steam, Air or Gas*

**Here is the Davis diaphragm motor valve with pressure controller that gives you accurate control for pressure reducing, pressure relief or back pressure service on steam, air, or gas!**

- **Panel or valve mounted controller. Quick, easy, adjustment for change of pressures.**
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DAVIS REGULATOR COMPANY
**2540 SOUTH WASHTENAW** **CHICAGO 8, ILLINOIS**


# SUPERPRESSURE PUMPS

*Continued from page 206*

able to operate the feed-pump turbine with inlet pressures under 150 psia, the boiler must supply live steam to the pump drive through a pressure-reducing station for all loads below 50,000 kw.

**Gas-Turbine Drive.** If the steam turbine may be used for feed-pump drive, there is no reason why we should not consider the gas turbine as a high-speed prime mover that can be direct connected to a centrifugal feed pump. This possibility is now arousing a great deal of interest.

One of the principal advantages of a simple-cycle gas turbine in large central stations is that the turbine discharges large quantities of hot gas. Heat content of the exhaust can be utilized in the station heat balance with the possibility of (1) increasing the power output of the generating station (2) improving the over-all heat rate. When the heat recovered from the exhaust is added to the heat equivalent of the mechanical power at the gas-turbine coupling, the cycle efficiency reaches a high value.

Because of the large investment involved, feed pumps intended for gas-turbine drive will probably be full-capacity units, designed to supply the entire feedwater needs of a given unit rather than half-capacity pumps, as is frequently the case with motor-driven units. This requirement for larger capacities will somewhat reduce operating speeds, so the pump design stays within a desirable specific-speed range. Such a reduction actually fits in rather well with gas-turbine characteristics since 3000- to 5000-hp units are presently designed to operate at 6000 to 7000 rpm.

The amount of heat at the turbine exhaust that can be utilized in the station heat balance is appreciable. For example, let's consider a turbine generator designed for 1800 psi and 1000 F. At the maximum capability rating of 170,000 kw, the pump must handle 1.14 million lb of feedwater per hr against a total head of 5100 ft and absorb 3800 hp. A single-shaft simple-cycle gas turbine driving such a pump would have an exhaust flow of 299,000 lb per hr at a temperature of 780 F. Turbine exhaust enthalpy would be 304 Btu per lb and total heat available at the exhaust 90,896,000 Btu per hr.

**Characteristics** of a feed pump operating at variable speed on a typical system-head curve and those of the gas turbine fit each other remarkably well. The combined operating curve is such that it is not far from being parallel to a constant exhaust-temperature curve throughout the entire pump capacity range.

Exhaust from the gas turbine can be

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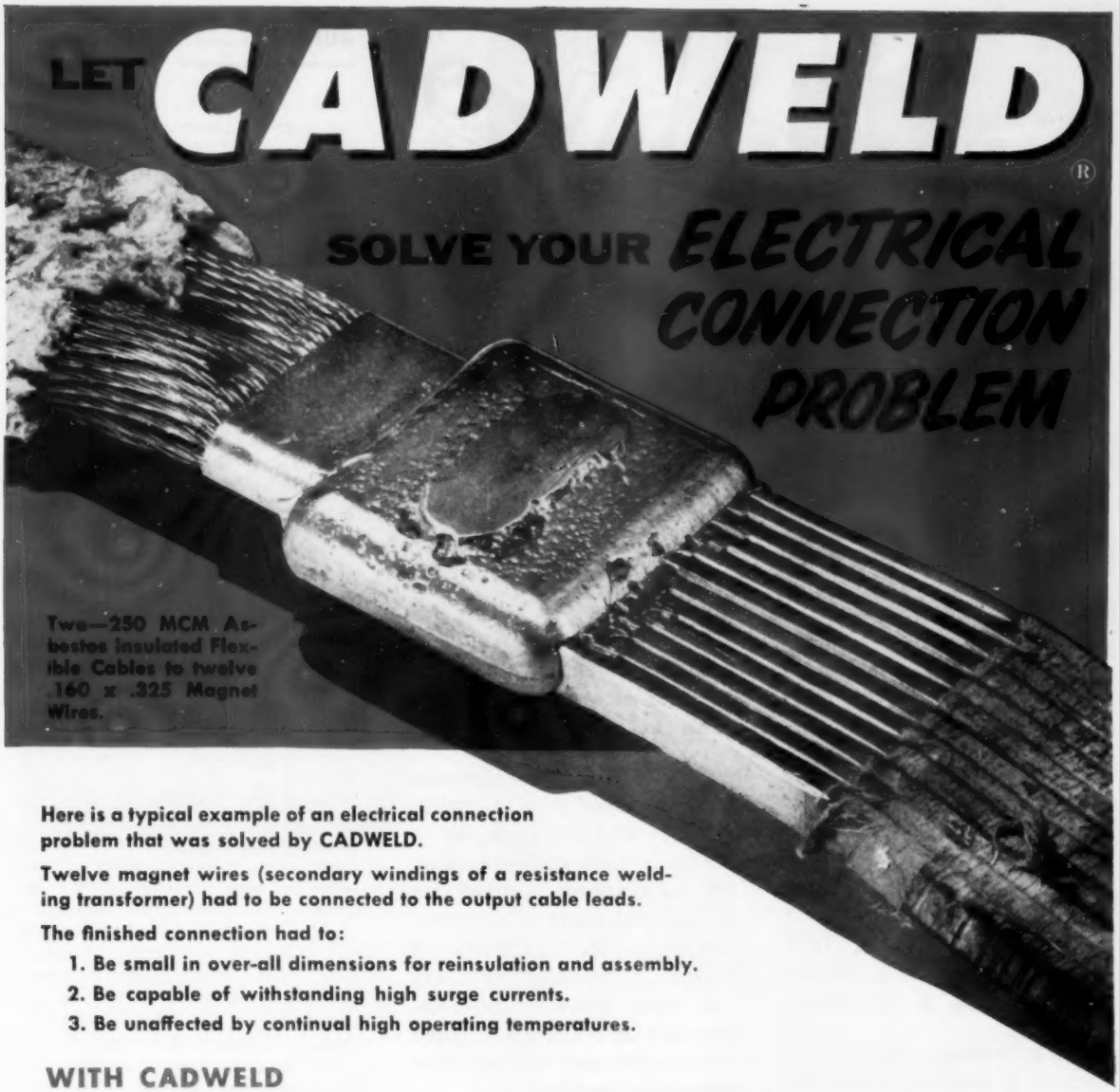

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## SUPERPRESSURE PUMPS

Continued from page 208

used for (1) heating feedwater (releasing steam for power and increasing station capability) or (2) providing additional heat in the furnace. Gas-turbine exhaust heat for raising feedwater temperature in nonfired heat exchangers is not new. Belle Isle Station of Oklahoma Gas & Electric Co uses this scheme. The turbine drives a 3500-kw generator instead of a feed pump.

Use of gas-turbine exhaust heat as direct combustion air in the furnace or as a diluent for temperature control of the gases in the superheater section may require some changes in boiler, forced-draft fan, air preheater and, perhaps, economizer design. All these problems need detailed study to determine the practical limitations of this type of feed-pump drive.

**Higher Frequency.** The dual problem of high-speed drive and variable-speed operation has one solution that is beginning to arouse much interest. It is the possible use of variable frequencies considerably higher than today's 60-cps standard. For instance, with 150 cps, a 2-pole motor can operate at 9000 rpm. If the frequency is raised to 300 cps, this speed can be met with a 4-pole motor.

Up to the present, frequencies other than 60 cps have been obtained by motor-generator sets. However, a bright future seems to be in store for an electronic frequency converter, not only for the sole use of feed-pump drives, but also for a great number of other utility and industrial applications. Development cost of such a converter, therefore, need not be carried entirely by its application to our problem, but should be borne by all its possible uses.

This application would use two electronic frequency converters. The first, or primary converter, would supply power at a constant high frequency. The secondary converter would supply power at a variable frequency to each feed-pump motor. Frequency variation would be dictated by the boiler or turbine-generator controls exactly as they are now intended to vary the speed of the hydraulic coupling.

High-speed motors, 6000 to 12,000 rpm from 1500 to 4000 hp, are not today available at prices that even approach that of a conventional motor running at 1800 rpm on 60-cps current and using a stepup gear. A 1500-hp 12,000-rpm motor would probably cost seven to eight times as much as a 1500-hp 1800-rpm motor and stepup gear. Overall length of the high-speed motor using today's materials and design techniques, would be about 2½ to 3 times that of an 1800-rpm motor.

# Wear Control

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Here's a proven way to bracket your Diesel cylinder wear costs and clamp them down to a minimum. The same can be done for compressors.

Just send your worn liners and cylinders to Van der Horst. If they've already been oversized to the limit, that doesn't matter. We can plate them all back to original bore dimensions with VANDERLOY M.

This pure electrolytic iron bonds atomically and can be developed a quarter of an inch thick, if that's essential.

Over the VANDERLOY M we plate PORUS-KROME*. It makes cylinders last as much as four times longer than they did when new and unprocessed.

Then, back they go, ready to give you efficient and dependable service, until at long last they need another Van der Horst processing.

Since the cost for all this is surprisingly less than the price for new, unprocessed replacements, we think you'll want to know more about our wear control method. Why not drop us a line? W52-1D

* *PORUS-KROME is a dense, hard, wear and corrosion-resistant chromium, produced by the Van der Horst Corporation of America, and which gives working surfaces an infinite number of tiny oil-retaining reservoirs for perfected lubrication.*

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"THIS LUBRICANT EXTENDED BEARING LIFE 50%"

—says REPUBLIC AVIATION CORP.
Makers of the famous F-84E THUNDERJET

"Under actual tests, LUBRIPLATE extended bearing life fifty per cent or better as compared to other lubricants. It was also found that, during test, LUBRIPLATE increased efficiency of machines twenty per cent by reducing friction loss. Republic has been using LUBRIPLATE successfully for the past eight years."

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## PUMPS

Continued from page 123

Some products require special heat treatment. Lacquered parts are baked in ovens through which hot air is circulated. Air is heated by coils fed from the hot-water system.

Besides supplying heat for all process units, the high-pressure high-temperature hot-water system provides sufficient space heat for the 165,000-sq-ft plant. Constant indoor temperature is maintained regardless of that outside.

**Results.** Seventeen years' operation at Synthane show (1) fuels savings exceed 20% (2) many accessories have been eliminated, reducing maintenance (3) sudden peak demands are easily handled by large heat reservoir in boilers (4) temperatures are easily controlled, giving a higher-quality more-uniform product. The system has sustained its high efficiency during several expansions to meet increases in plant growth.

## HYDRAULIC UNITS

Continued from page 99

button to start and stop pump motor.

**Elevators.** Modern hydraulic freight or passenger elevator is a highly refined development of the hydraulic lifts we have been considering. Sketch, Fig. 5, is a passenger type, but freight elevator has the same general design except it can handle heavier loads, stand greater shocks and side thrust. These elevators differ from electric designs in several ways: First is their extreme simplicity. Car and its sling rest on the hydraulic plunger by which it is lifted. There are no wire ropes; therefore, no overhead sheaves nor penthouse.

Since there is no overhead equipment, hoistway columns and footings may be of smaller design. Car safeties or speed governors are not needed because car and its load cannot fall faster than normal speed. Hydraulic elevators travel at low speeds, so pit under car can be quite shallow and the bumpers but heavy springs.

Electric equipment in hoistway and on car is not shown in diagram, but it too is simple, consisting chiefly of wiring to car pushbuttons and lights.

**Elevator Ratings.** Capacity of passenger elevators ranges from 1000 to 4000 lb at speeds from 40 to 125 fpm. Since electro-hydraulic elevators lower by gravity, down-speed may be 1.5 to 2 times up-speed with help of simple valve adjustments. Thus, average speed for a round trip can be considerably higher than up-speed. For example, if up-speed is 60 fpm and down-speed 90 fpm, the average is $(60 + 90) \div 2 = 75$ fpm.

(Continued on page 214)


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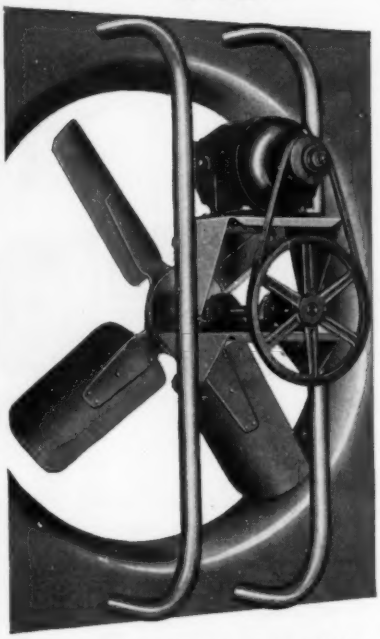

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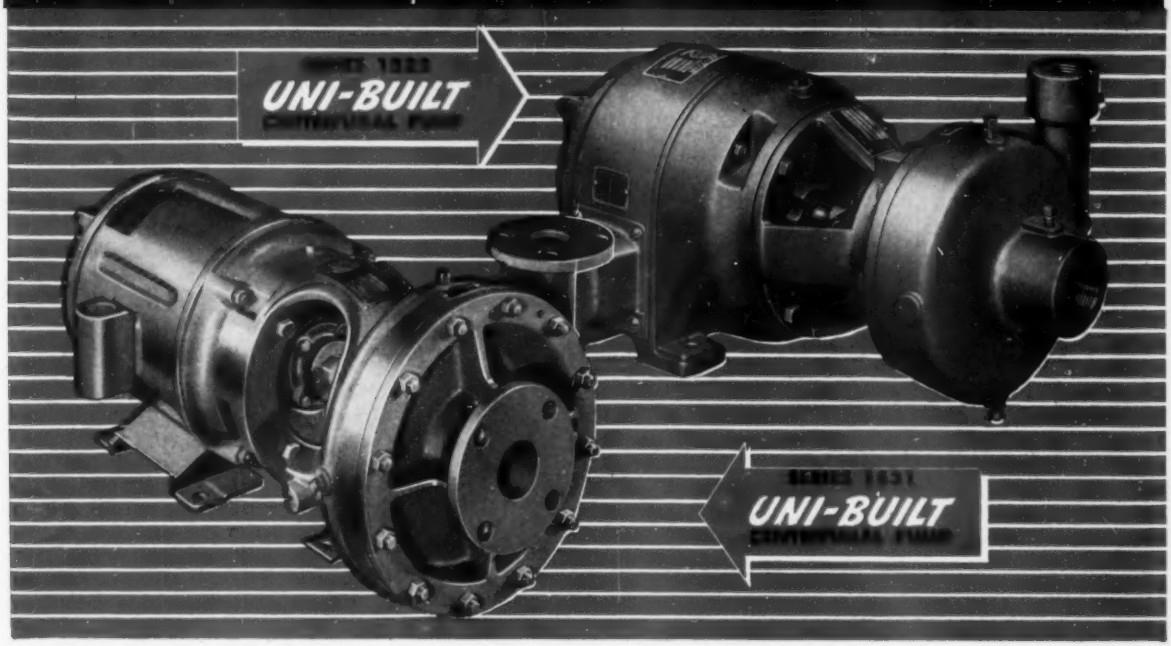


**Sizes, capacities and prices on B & G Series 1522 and 1531 Stock Pumps are given in a bulletin available upon request. Send today for your copy.**

**B & G manufactures a comprehensive line of Hydro-Flo Centrifugal Pumps and Heat Exchangers for industrial applications. Send for catalogs.**

These are *the* pumps which stand up under hard service in industrial plant applications! For your convenience, a stock of most commonly used sizes is maintained at the factory—ready for immediate shipment.

The leak-proof "Remite" Mechanical Seal alone makes these pumps a *buy!* This new-type Seal is harder than glass—wear-proof, corrosion-resistant. It's self-lubricating and eliminates the usual leakage through the packing gland—assures trouble-free operation.

**Smooth running . . . quiet!**

Oversize bearings hold the shaft in alignment for smooth, quiet performance...balancing of the impeller prevents shaft vibration and seal failure. All parts are machined to rigid specifications, carefully inspected and assembled—assurance of minimum installation and maintenance expense. B & G Series 1522 and 1531 Pumps kept in stock at the factory are bronze-fitted only, but are available as all-iron, all-bronze or stainless steel units.

With all these advantages, you'll find them competitively priced!

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*Canadian Licensee: S. A. Armstrong Ltd., 1400 O'Connor Drive, Toronto, Canada*

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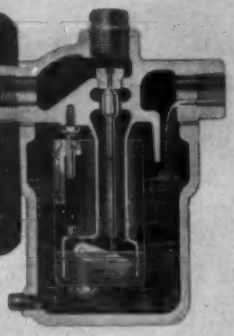
DESIGNS THAT REPRESENT 50 YEARS TRAP BUILDING EXPERIENCE



# "airxpel"

## STEAM TRAPS

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**This equipment offers design advantages that represent long experience in building steam saving devices for industry.**

**Orifices of Wright-Austin traps can be interchanged without disassembling the trap. Connections are the straight-through type. Both of these features contribute to speed and ease of installation.**

**Wright-Austin traps are available for lines ½" to 3", for pressures up to 600 P.S.I.G. and with capacities up to 65,025 pounds of water per hour.**

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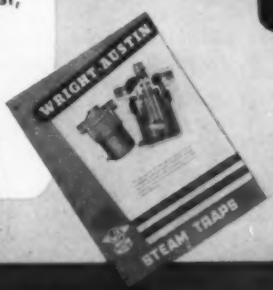


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## HYDRAULIC UNITS

*Continued from page 212*

This feature is inherent in the equipment.

Standard freight-elevator capacities run from 2000 to 20,000 lb at 20 to 85 fpm, but units can be designed for 100,000 lb or more. Rises to 50 ft, adequate for 2- to 5-story buildings, are the most practical and economical for freight and passenger service. Within this rise range, casing and plunger can be made and installed in one piece—far simpler than when these parts must be assembled in sections. For higher lifts car speed may be greater, increasing power needs and complicating control.

For freight-elevator maximum economy and top service, an up-travel time lapse of 30 sec between floors is recommended for a 3-floor lift where unit is not part of a production line. This means travel from first to third floor takes one minute. Where faster speeds are needed, equipment is available up to 125 fpm. However, higher speeds require greater pump capacity, more motor power and more complicated control materially adding to costs of elevator installation and of operation. For short-run passenger elevators figure 15 sec between floors in average service. But this, too, can be reduced to about 5 sec or 120 fpm.

**Cars Available.** Passenger and freight cars for electro-hydraulic elevators are comparable with electric designs in every way. They'll meet requirements of the most rigid safety codes.

Passenger elevator can be equipped with any entrance design specified. Frames, sills, doors, trim, door-hanger covers are available in a wide range of patterns, metals, finishes and colors. Elevator-door designs can be simple or ornate, modern or traditional, to match building interior.

*Acknowledgments: Material used in this article was supplied by Globe Hoist Co, Rotary Lift Co, Shepard Elevator Co, S Heller Elevator Co, Rosenberg Elevator Co, Murphy Elevator Co and White-Evans Elevator Co.*

## INSULATING OIL

*Continued from page 93*

But after an oil has been thoroughly reconditioned, it will have a solvent action on any sludge left in the transformer and will gradually dissolve it back into the oil. This requires several months, however. At intervals of a year or so, it may be necessary to give the oil another light fuller's earth treatment to remove dissolved sludge. After a few such treatments, a rather dirty transformer can be cleaned up and be good for several more years of service with-

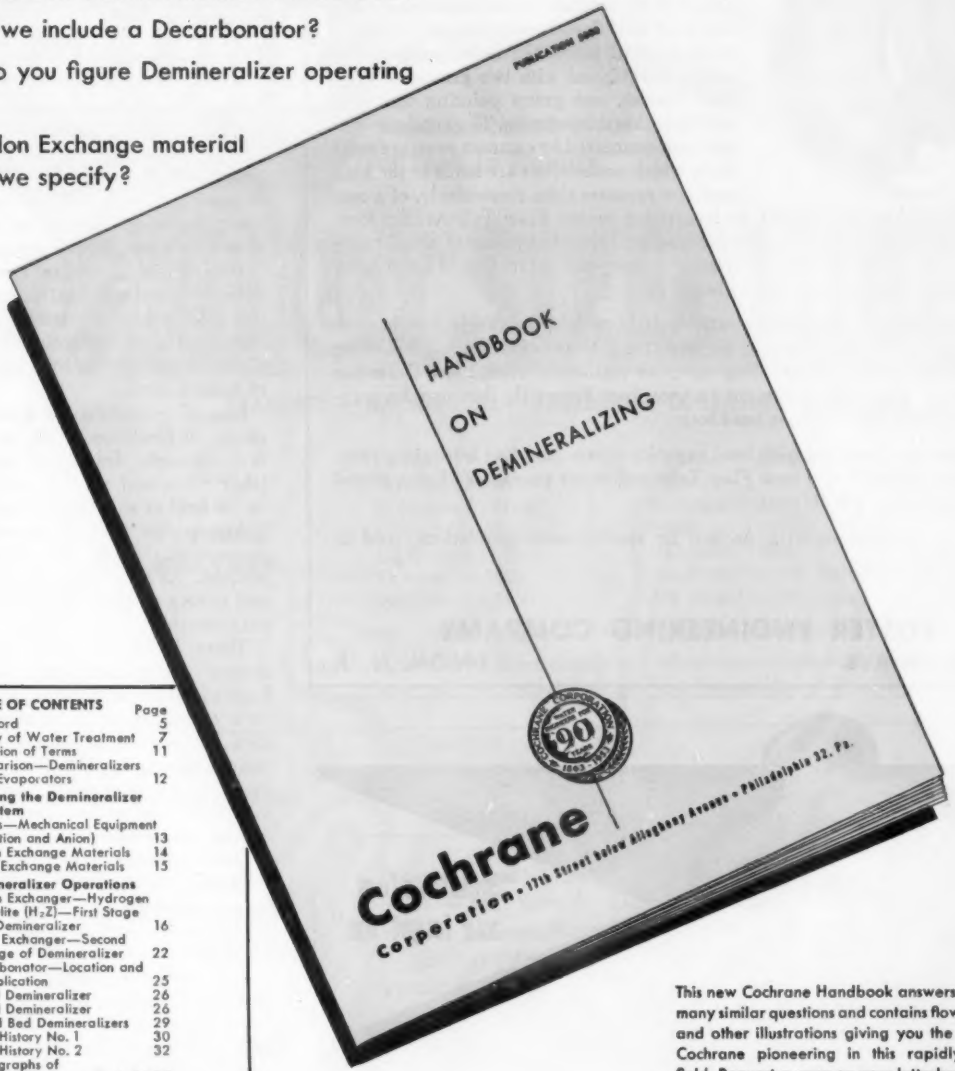
Why is Demineralization being selected instead of Evaporators?

When should we use three or four-bed rather than two-bed Demineralizers? Mixed Bed?

Should we include a Decarbonator?

How do you figure Demineralizer operating costs?

Which Ion Exchange material should we specify?

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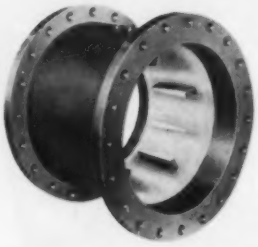

The Flow Tube is an impact-type head meter designed for accurate measurement and regulation of fluid flow. It consists, essentially, of a short spool piece, the inner periphery of which is equipped with two groups of pressure nozzles, one group pointing upstream and the other downstream. The nozzle groups are inter-connected by common pressure rings from which connections are made to the high and low pressure sides respectively, of a conventional indicating, recording or integrating meter. Flow Tubes differ from other variable head meters in that the taps are located at points of equal cross-sectional area. Therefore, the differential developed is a function of the velocity head and independent of the static head.

Flow Tubes are compact, comparatively light weight, relatively low in cost, and are easy to install since they require straight runs entering and following only when installed near throttling valves or regulators. And, Flow Tubes are available in types and D/d ratios to provide differentials that can be accurately measured with the least head loss.

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## INSULATING OIL

Continued from page 214

out major cleaning. Heat-transfer ability of transformer improves as existing asphaltene coatings dissolve in reclaimed oil.

*"For reclaiming, figure on about 0.5 to 1 lb of fuller's earth per gallon of oil"*

Amount of fuller's earth necessary for purifying can be estimated by consulting a fuller's earth acid-adsorption chart, *sketch*, p 93, *left*. Different oils respond differently to fuller's-earth treatment. Some oils need more earth than shown on chart, others require less.

Oil's initial condition usually influences the desired, final purified condition. A badly deteriorated oil can be reclaimed to an interfacial tension value higher than 40 dynes by adequate doses of fuller's earth.

Cost of reconditioning a used oil depends on condition of oil, its response to treatment, degree of purification, labor rates, and whether work is done in the field or at a central station. Purifying in the field is generally more economical than in central reclaiming stations. As a rule, cost of conditioning and adding an oxidation inhibitor is less than one-third the cost of new oil.

There is always some makeup oil needed during reclaiming operations. Loss of oil by absorption into the fuller's earth ranges from about 5% to 15%, depending on whether the used cartridges are allowed to drain thoroughly or whether they are thrown away immediately after using. Considerable oil can be recovered by adequate draining of used cartridge or by blowing out oil from the cartridges with compressed air before removing cartridges from filter.

Life expectancy or stability of an uninhibited reclaimed oil depends, more or less, on the oil itself and the degree to which it has been reclaimed. It usually can be expected that stability will be somewhat less than new oil. The better the condition to which an oil is reclaimed, the higher its stability. A new oil will practically always have a higher stability than a reclaimed oil so there is no objection to using a new oil as makeup.

When reclaimed oil is mixed with new, stability is usually lower for the mixture than the arithmetic average of the two. For that reason, reclaimed oil should not be mixed with new as makeup. Stability of a mixture of oils will never be less than the stability of a lower-rated oil.

During recent years it has become common practice to add oxidation inhibitors to both new and reclaimed oils. Inhibitor that seems to have widest acceptance by both equipment manufacturers and power companies is di-ter-

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| | |
|---|---|
| Carbon | 5 Chrome ½ Moly |
| Carbon ½ Moly | 7 Chrome ½ Moly |
| ½ Chrome ½ Moly | 8 Chrome ½ Moly |
| 1 Chrome ½ Moly | 8 Chrome 1 Moly |
| 1¼ Chrome ½ Moly | 9 Chrome 1 Moly |
| 2 Chrome ½ Moly | 3% Nickel 7% Nickel |
| 2¼ Chrome 1 Moly | 5% Nickel 9% Nickel |

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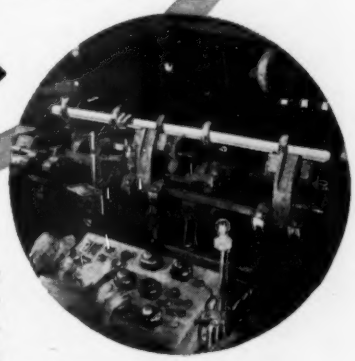

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## INSULATING OIL

*Continued from page 216*

tiary-butyl-para-cresol, commonly known as DBPC. This chemical is completely soluble in oil and insoluble in water. It is easy to use and is nontoxic. DBPC forms oil-soluble products and is not harmful to the transformer.

*"Below 180 F, DBPC oxidation inhibitor is not removed by fuller's earth"*

Furthermore, DBPC is not removed by normally used methods of dehydration and degasification.

Some oils, both new and reclaimed, have better inhibitor "susceptibility" than others. Increase in stability of an oil is determined by its susceptibility and the amount of inhibitor used. Stability of both new and reclaimed oils can be increased considerably by addition of inhibitor. There are no adverse effects, from mixing DBPC inhibited oils with noninhibited oils or reclaimed oils, other than that stability of the mixture will be below arithmetic average of the two. In no case will stability be lower than stability of lower-rated oil. There have been no adverse effects noted by using inhibited oils in circuit breakers.

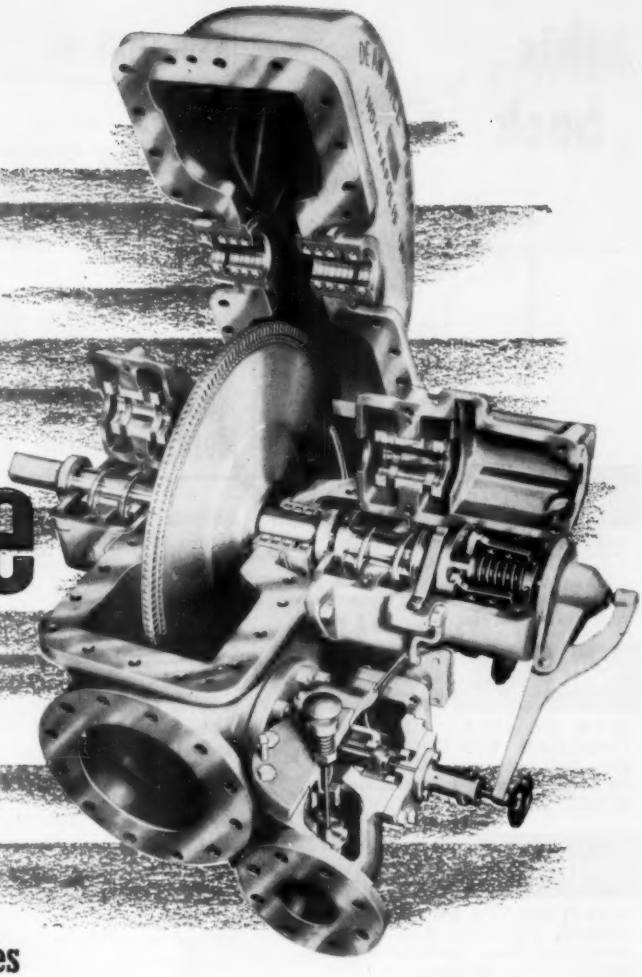
Extent of adsorbent treatment is an important consideration. In general, the greater the adsorbent dosage, resulting in a higher interfacial tension, the greater the stability increase for a specific inhibitor addition. As interfacial tension value approaches that of new oil, a larger amount of adsorbent is needed for small increases in interfacial tension.

It may be more costly to recondition oil to a high interfacial tension value than to use lower adsorbent dosages and increase inhibitor concentration. Stability for a specific oil varies as amount of inhibitor added; the higher the concentration of inhibitor, the higher the stability.

To arrive at an accurate economic balance between the degree of adsorbent treatment and amount of inhibitor addition for the desired stability, it may be best to run a series of accelerated oxidation tests. However, many operators have adopted as standard practice the addition of 0.3% by weight of DBPC to their reclaimed oil without the benefits of accelerated oxidation tests.

DBPC is a crystalline solid and should be dissolved in oil before it is added to oil in the transformer. If solid DBPC is added, it may settle to transformer bottom undissolved. It is quite easy to dissolve DBPC in oils around 140 F with a little agitation. It can also be dissolved by first melting and then pouring it into the oil. DBPC solubility in transformer oil at ordinary temperatures is

# up to 100% more power



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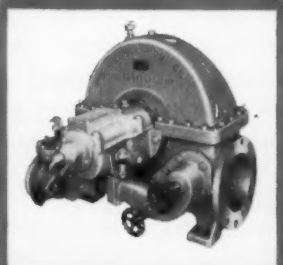

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## INSULATING OIL

Continued from page 218

approximately 30% by weight. A 20% solution is more desirable if it is to be stored at cold temperatures because of possibility of some crystallizing out. A DBPC solution can be mixed mechanically with oil to be inhibited, or it can be added to oil in an energized transformer near top of the oil level. Natural convection currents caused by transformer heat distribute it uniformly.

## More TECHNICAL BRIEFS

Begins on page 156

depends on nature of noise source, techniques and materials available for noise control and compromises possible in arriving at a workable solution. Possible methods of noise control include such devices as redesign of a noisy machine, use of sound barriers, acoustical insulation and the wearing of ear plugs by exposed personnel.

This paper is confined to techniques for noise reduction used by acoustical engineers who are asked to control noisy machines by methods other than redesign. It deals with such subjects as mechanical vibration as a source of sound, sound in closed places, noise from centrifugal and axial-flow compressors, the use of mufflers and silencers and sound traps, vibration isolation, barriers and sound absorbers, noise from pipe walls and blower casings, reduction of room reverberation and unit sound absorbers. *ASME paper No. 53-A-55.*

### Water Treatment

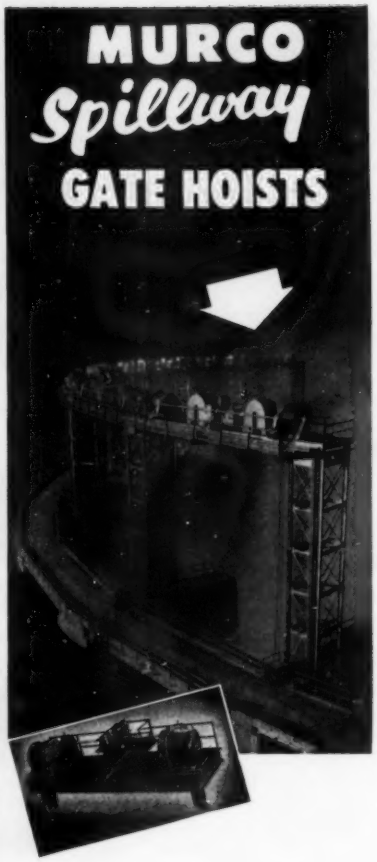
**Mixed Bed Deionization.** *By W S Morrison, Illinois Water Treatment Co.*

The principal purpose for presenting this paper is to get into the records the present-day status of mixed bed deionization now entering its fifth year. Reports on operating procedures, plus other features from 15 major field installations scattered across the country, make up the background for the author's comments.

Water quality produced depends on several factors: temperature, type of resin, chemical regeneration level, flow throughput. Resistivity of the effluent water averages 6-7 megohms throughout a cycle. At the outset this resistivity runs 1 megohm and reaches a peak of 10-15 megohms until the breakthrough. Silica appears almost simultaneously with the first break in resistivity.

The theoretical pH and resistivities vary with temperature. For example at


**MURCO Spillway GATE HOISTS**



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## More TECHNICAL BRIEFS

Begins on page 156

10 C, specific resistance is 36 megohms and pH 7.26. At 50 C specific resistance becomes 6 megohms and pH, 6.64. But the range of temperature normally encountered in ion exchange work does not seriously affect the exchange rate. So comparisons between deionized water supplies from different sources can be made.

Mixed bed deionizers work best with low turbidity waters, below 5 ppm. Silica removal is excellent. One major problem that has been plaguing the mixed bed design is the tendency of certain organics to slime up or coat over the exchanger resins and to affect performance seriously.

At the moment the author feels that chlorine compounds with large molecular structure or other oxygen-consuming chemicals of similar physical arrangement may prove the answer to the organic coating-over problem. *ESWP Paper, No number.*

Directions for ordering papers on p 158

**Filter Aid Filtration of Water.** *By G R Bell, Johns-Manville Corp.*

Filter aid water filters are generally pressure filters. All makes have the same substantial operating procedure to fit them for routine operation. The basic essentials are a filter, filter feed pump, precoat system, a rate of flow control and usually a slurry feed system.

There are three basic operating steps: precoating, running and backwashing or cleaning. Precoating gets its name from the practice of applying a thin layer or coating of clean filter aid to about 0.1 lb per sq ft to the filter surface before exposing it to the water.

After precoating, the water to be filtered is pumped into the filter and can leave only through the precoat into the filtered side of the water system. Only if the water is very clean can you count on the filtration cycle having any appreciable run. Usually the incoming water lays down an impervious slime on the face of the precoat. Some additional filter aid has to go on, a so-called body-feed added at the start of the cycle to the incoming water. This body-feed keeps the filter cake in an open, porous condition.

Finally, when the thickness of filtered out material cakes up to create a preset maximum resistance to flow or loss of head, backflushing or backwashing is done. This is usually a remote type of operation with manual cleanings scheduled infrequently.

Successful remote cleaning seems to be a combination of proper filter septum (that is the openings between the filter elements like the air spaces in the

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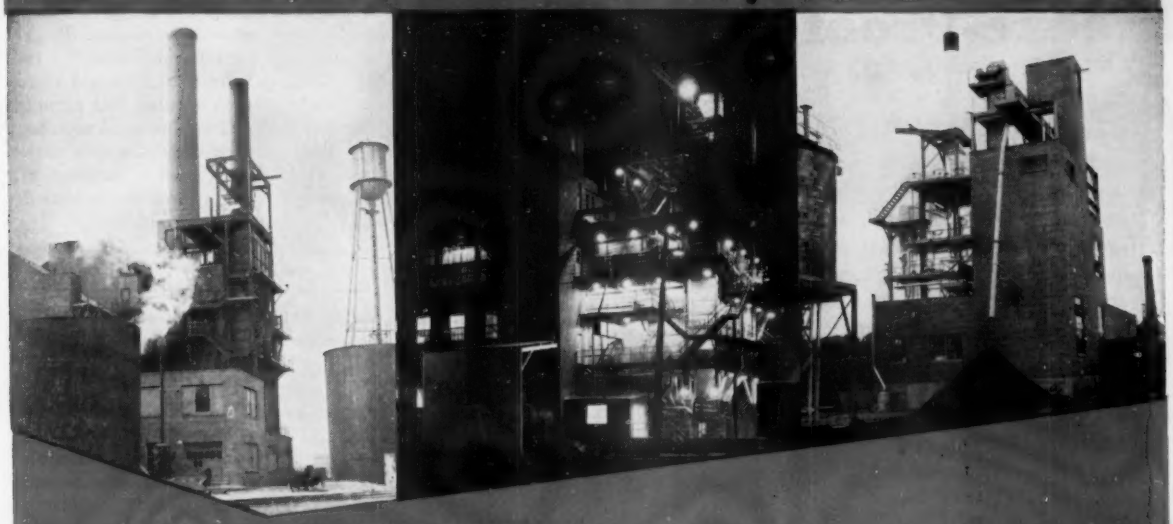
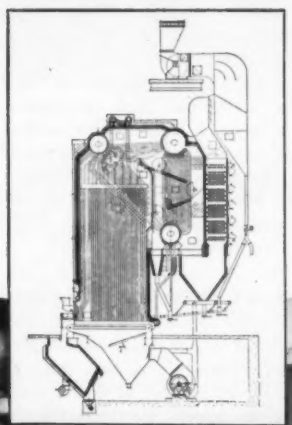


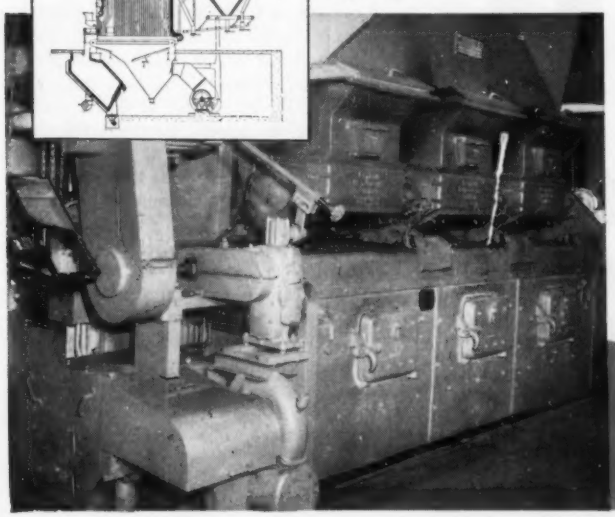
## Selected for "SEMI-OUTDOOR" Boiler Plants

# DETROIT ROTOGRATE STOKERS



**AT OTSEGO**

75,000 pound unit with superheater and economizer. 650 pounds pressure 750° F steam temperature. Based on Ohio Strip Mine coal—10,800 BTU.



**Savings in building structure costs are substantial. May run as high as 15% of the total investment in the boiler, stoker and accessories, according to Cummins & Barnard Inc., Consulting Engineers, Ann Arbor, Michigan.**

**Here are representative RotoGrate "semi-outdoor" installations made under the direction of these Engineers.**

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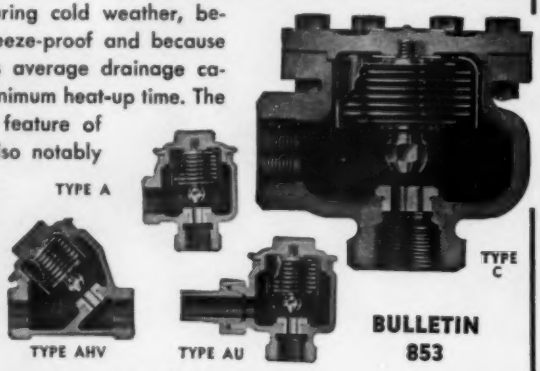


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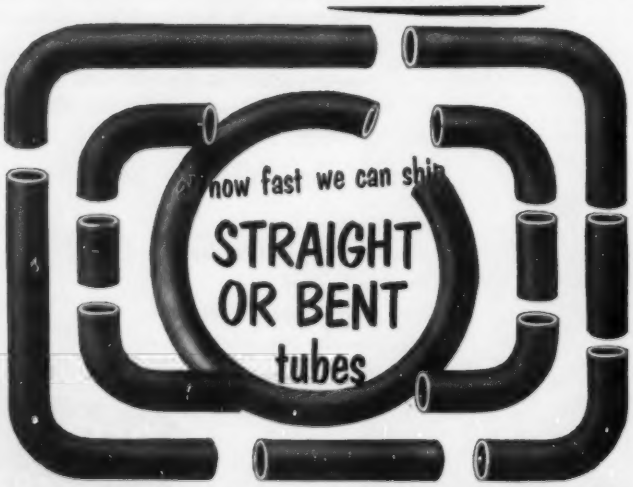


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## More TECHNICAL BRIEFS

Begins on page 156

weave of a cloth) and the proper precoating and removal techniques. To get good precoating remember that (1) for any particular grade of filter aid there is some maximum opening that permits the easy bridging vital to good filtering, (2) there must be a suitable concentration of filter aid and a satisfactory velocity to permit precoat formation. *ESWP Paper, No number.*

Directions for ordering papers on p 158

**Metal Failure Encountered In Water Treatment.** *By E N Johnson and A O Walker, National Aluminate Corp.*

Metallographic studies and correlation of information from other sources such as water, gravimetric and X-ray analyses have proved highly valuable tools in identifying metal failure causes. Water treatment specialists can give a very accurate diagnosis with such data plus consideration of plant conditions and operating history.

The authors describe the steps to take for furnishing a suitable sample for metallographic work and the five major categories into which metal failures fall. These categories are overheating, cracking, corrosive attack, external tube attack and copper alloys.

The paper brings out the various metallurgical changes overheating produces such as spheroidization, distorted microstructures, decarburization and grain growth, quenching effects, intergranular oxidation, high temperature creep. They similarly review each of the subdivisions of the other major categories. As such, the paper is highly valuable for reference and as an individual engineer's background. *ESWP Paper. No number.*

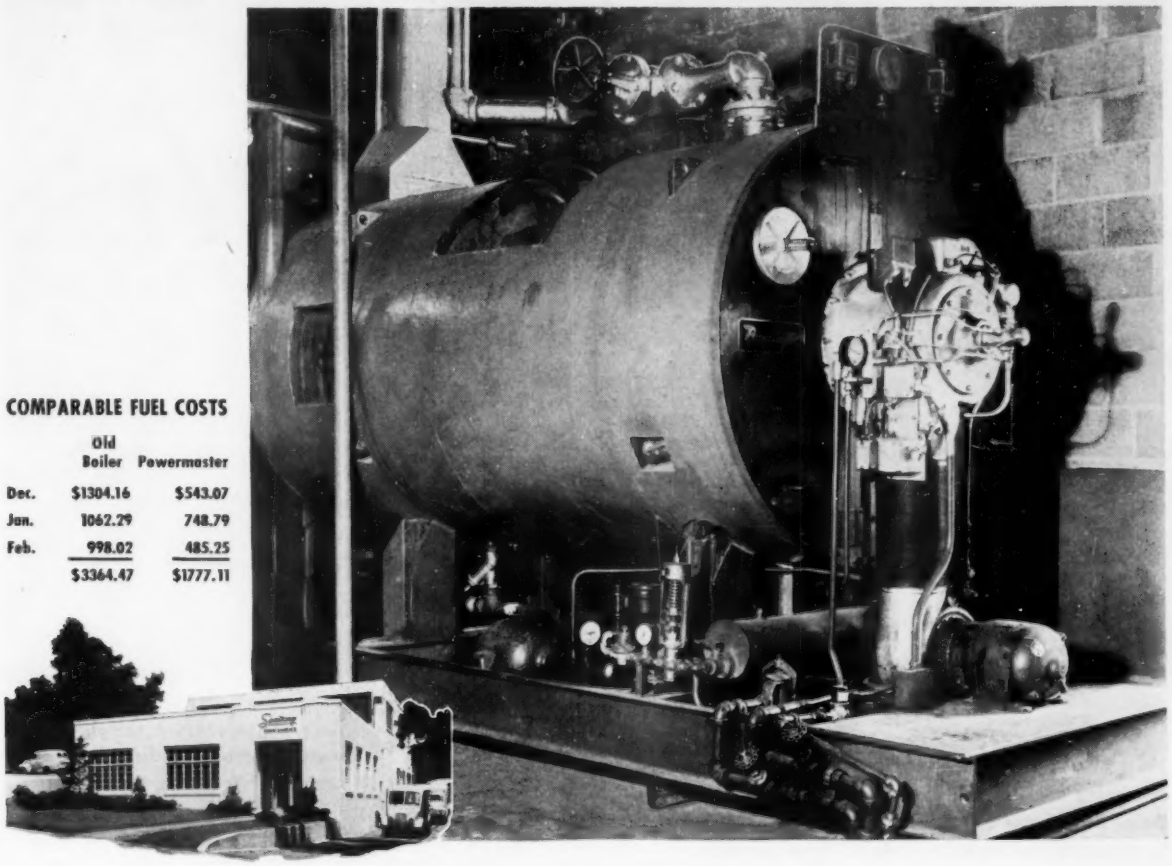
**Experiences With Corrosion and Depositions In An Oil Refinery.** *By L N Schamberg and E F Lynch, Gulf Oil Corp.*

The oil industry has had long experience in the control of deposits and corrosion in closed water circulating systems employing cooling towers. This paper details the author's particular experiences at their company's Philadelphia refinery.

There they take raw Schuylkill River water for makeup, pretreat it with chlorine to a 0.5 ppm residual, then coagulate it with alum and activated silica to wind up with a pH of 7.1 to 7.3. Next come sand filters and finally a post-chlorine treatment to bring residual chlorine back to 0.5 ppm and a postcaustic addition to restore water to a 7.2 pH.

Before 1946, the water in the circulating system was maintained at a point neutral to the Langelier Saturation In-

# in FOOD PROCESSING PLANTS



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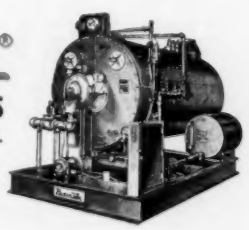
**PACKAGED AUTOMATIC BOILERS**
In sizes to 500 HP; pressures to 250 psi.



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Units #1 and #2 are in operation. The fans for Unit #3 have been designed and are being constructed. They will be larger than the fans for the first two units. Boiler #3 will operate on the same type of fuel (pulverized coal) and is expected to generate one million pounds of steam per hour.

Each boiler now in service is served by two Forced Draft and two Induced Draft Fans with the following specifications:

**F. D. Fans** Double inlet with radial inlet vanes; outlet dampers; rain hoods and recirculating duct connections. Capacity for each fan: 110,500 cfm; 100 F; 14.7" SP; 1180 rpm; 348 hp.

**I. D. Fans** Double inlet, special control type inlet dampers and outlet dampers. Capacity of each: 187,000 cfm at 350 F; 13.5" SP; 880 rpm; 566 hp.

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*Sanderson & Porter, Engineers

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## More TECHNICAL BRIEFS

Begins on page 156

dex and the concentration of dissolved solids at 3 to 5 times the incoming makeup water. Caustic additions to maintain the Langelier Index were put in the filtered makeup water at the filtration plant.

Since 1946 the central points for the circulating water treatment were established as follows: (1) Hold pH high enough (about 7.8 to 8.0) to prevent corrosion according to the Langelier Saturation Index (to a slightly negative point never below –0.5) by adding an alkali directly to the cold well of the cooling tower. (2) Add chromate to maintain a chromate concentration between 200-500 ppm to prevent corrosion. (3) Follow up with a polyphosphate (about 3.5 ppm, P04) to sequester any hardness if deposits should develop from steps 1 and 2. (4) Finally, add chlorine up to 0.1-0.5 ppm in such quantities as to render the water toxic to algae growth or slime. Incidentally, concentrations based on total chlorides should not exceed 1200 ppm or 5 to 7 times that of makeup water.

The chromate shortages affected this ideal program and the author's company tried several substitute methods such as silicate treatment that proved of doubtful effectiveness, polyphosphate, cathodic protection. Their results make up the balance of the paper. *ESWP Paper, No number.*

### Miscellaneous

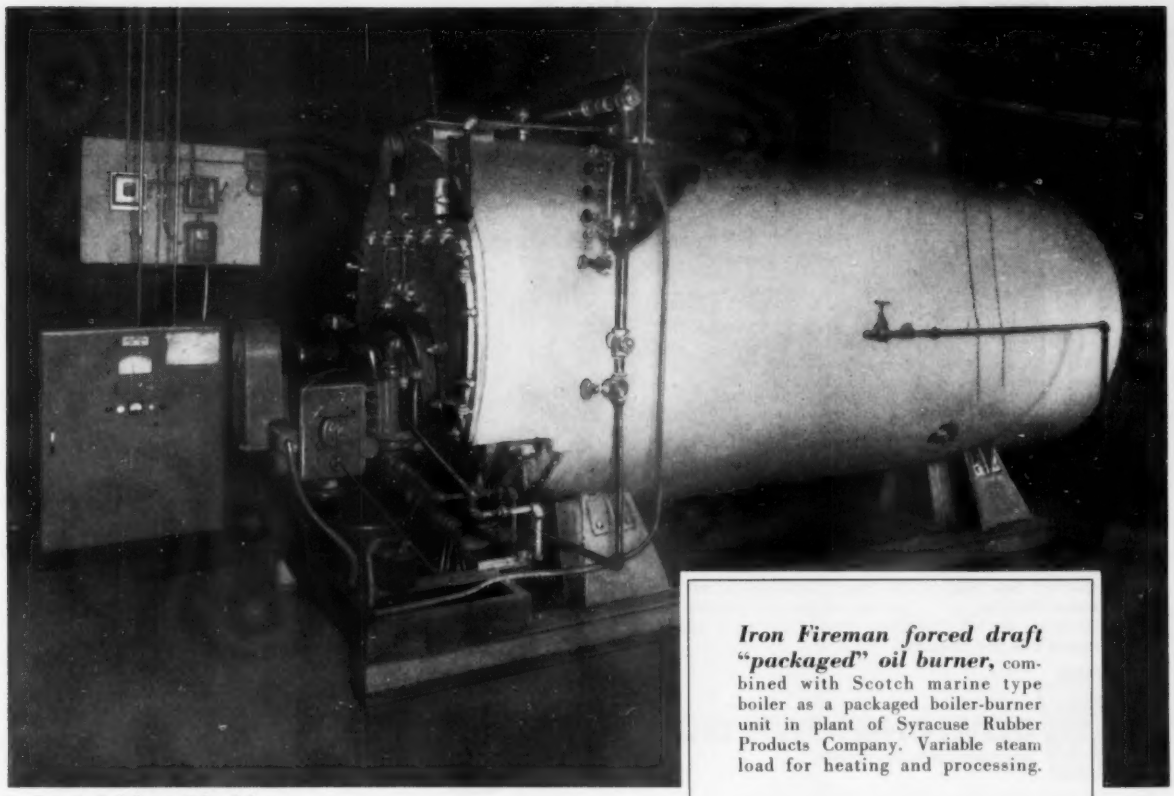
**Recent Advances In Chemical Cleaning.** *By P H Cardwell, Dowell Inc.*

Hydrochloric acid, the principal solvent used today for cleaning, may not hold its place in the future. To increase hydrochloric acid's efficiency—or phosphoric acid's, for that matter—the temperature of the treatment as well as its concentration has to be upped and better and better inhibitors are needed to protect basic metals. A very recently developed polyethanol amine is more effective than the older coal tar chemicals.

This new inhibitor is surface active and functions as a combination inhibitor and wetting agent to prevent more effectively attack of the metal by the acid. Now work is progressing on developing even better inhibitors. When these come along nitric acid may come into the picture.

Along with this development is another parallel advance in the way of completely new scale removal chemicals. These new scale-removal cleaners would solve many of the problems of acid

Directions for ordering papers on p 158



*Iron Fireman forced draft "packaged" oil burner,* combined with Scotch marine type boiler as a packaged boiler-burner unit in plant of Syracuse Rubber Products Company. Variable steam load for heating and processing.

*Installation by R. C. Dreves, Goshen, Ind*

# Boiler capacity doubled . . . no increase in fuel cost

***That's the experience of Syracuse Rubber Products Co., Inc., Syracuse, Indiana, with IRON FIREMAN packaged oil burner***

This new steam plant, with complete oil firing system by Iron Fireman, carries twice the load of the old one. Steam pressure has been stepped up from 90 to 125 psi. In spite of this doubled output, "the cost is about the same as the previous plant to operate," says Mr. Hubert R. Anglemyer, President. "We also have drier steam in our processing, which cannot be measured in dollars. We have had no down time. Dependability of equipment and ease of operation and maintenance are outstanding."

For further information mail coupon, or call your Iron Fireman dealer.

***Iron Fireman advantages***

**1.** Packaged burner unit (for oil, gas or oil-gas combination firing) is assembled and tested at factory instead of on the job. No divided responsibility for burner, electrical wiring, control system, oil heating equipment.

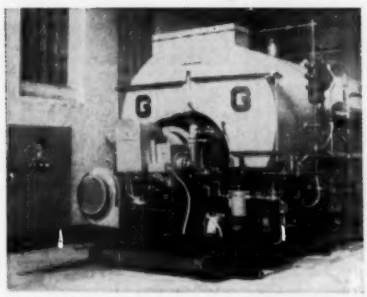
**2.** Applicable to nearly all types of boilers.

**3.** Continuous high combustion efficiency.

**4.** Forced draft. No high stack needed with Scotch or sealed firebox boilers. Requires only vent pipe.

**5.** For gas or oil, or both. Combination burner shifts fuels at a moment's notice.

**6.** Burns low cost oils (No. 6 or lighter).



**Old steam plant out—new one in—steam up—all within 36 hours.** Scotch marine boiler with Iron Fireman packaged oil burner being rolled into the plant of the Meadowsweet Dairy, Tacoma, Wash. This unit was in operation just 36 hours after the crew walked in to dismantle the old boiler—a graphic example of savings in labor and production time. Installation by Lawler Boiler & Heating Co., Tacoma

IRON FIREMAN MANUFACTURING CO.
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Please send detailed information on Iron Fireman packaged burner units for oil, gas, and oil-gas combination firing.

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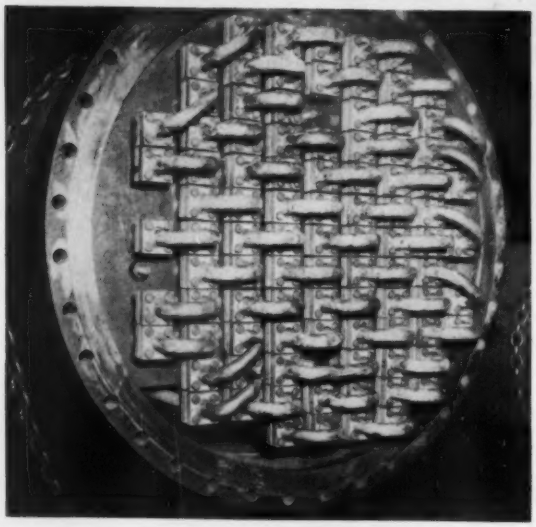

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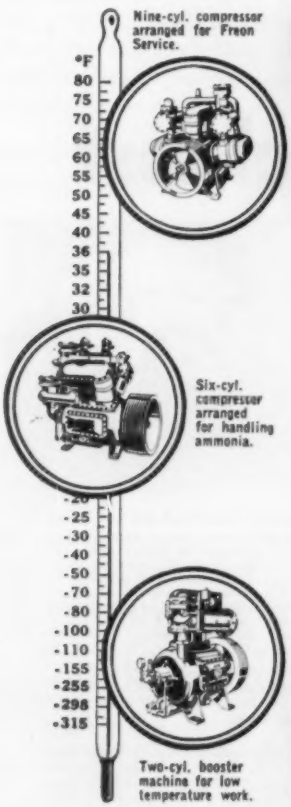

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# More TECHNICAL BRIEFS

Begins on page 156

cleaning such as acid corrosion, how to get rid of spent solvent and after-rusting control.

Organic acids and their salts, unlike mineral acids, are removed completely or are destroyed by high temperature so they do not raise any question as to their effect in non-drainable elements like some superheaters in power boilers.

Another development, thickened solvents or paste—such as materials formed from acid and alkaline solutions with various gellifying agents, gives a stabilized, thickly viscous fluid over a wide range of temperatures. Concentrations of acid as high as 28% can be incorporated into these thicknesses. These pastes do a splendid job when sprayed on large volume units where costs of the traditionally low strength acid concentrations in the desired quantities were extreme.

Another solvent material coming to the fore is the emulsion of an organic solvent with either acid or alkaline solutions in either the acid-in-oil or the oil-in-acid forms. They can be tailor-made to meet any particular deposit and class of unit being cleaned. By selecting the right emulsifying agents, you can get any degree of stability, any thickness from water-like to cream-like consistencies and with practically any liquid organic solvents such as hydrocarbons or chlorinated solvents.

Chelating agents, those special compounds that form complexes to remove various ions from solution, are another possibility. Up to date their costs have worked against them. They can do an excellent job of removing copper from boilers as one case. *ESWP Paper. No number.*

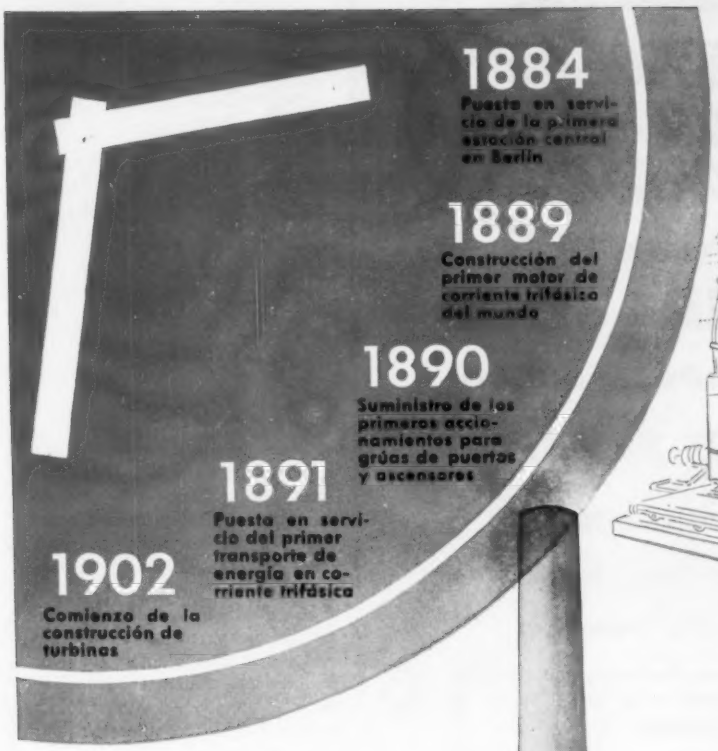
*Directions for ordering papers on p 158*

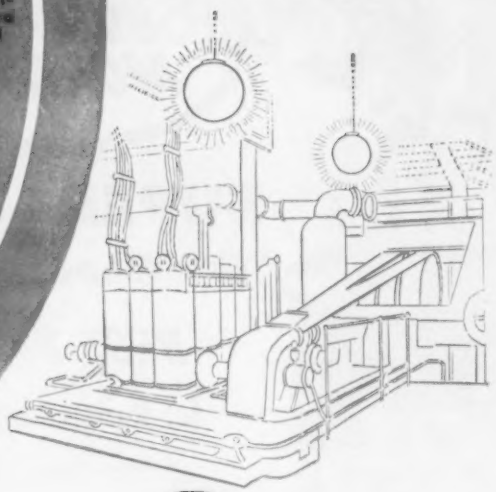
**Steam Purity Observations and Institutional Plants.** *By R W Lane, T E Larsen and J W Pankey, Illinois State Water Survey Div.*

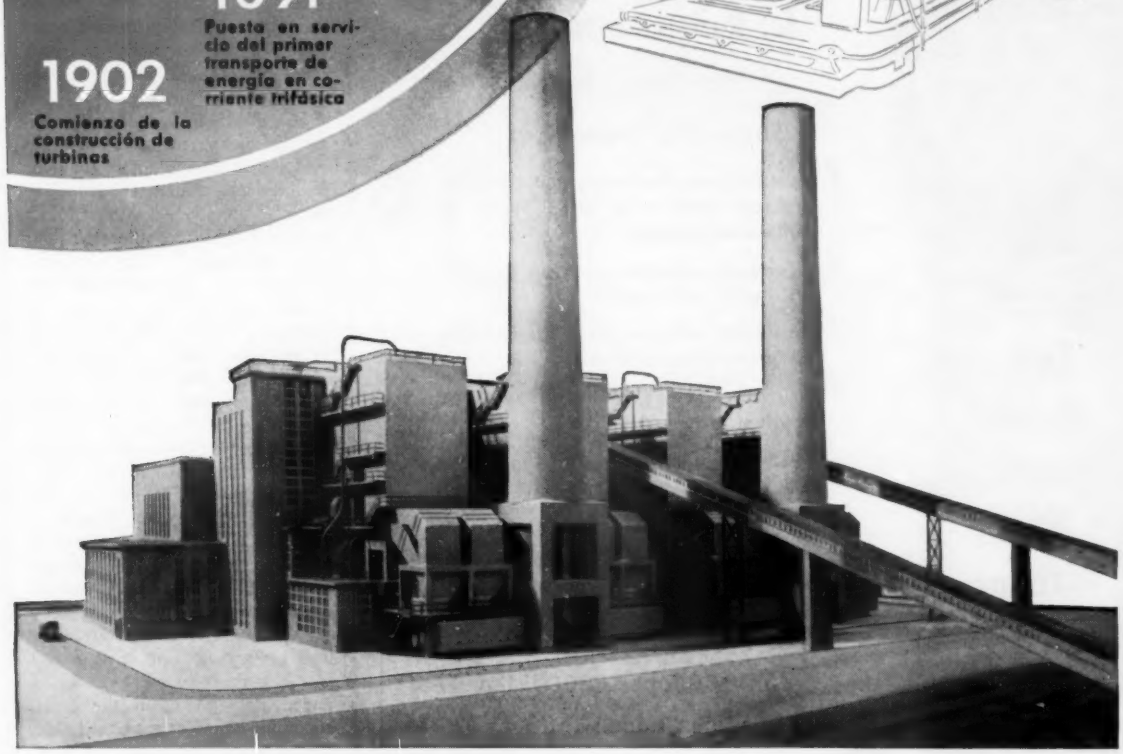
This special study for low pressure boilers, 250 psi and under, was primarily carried out to determine water treatment, boiler design factors, blowdown limits and operating procedures to give high purity boiler steam.

Accordingly the authors have developed a new chart showing relationship between $CO_2$ and $NH_3$, pH and conductivity for applying corrections for gas contaminants in steam purity, plus a method for determining parity with least interference from contaminants, a relationship between organic treatments and water hardness plus some knowledge of blowdown limits basically sound for individual plants. *ESWP Paper. No number.*

# AEG


1884
Puesta en servicio de la primera estación central en Berlín
1889
Construcción del primer motor de corriente trifásico del mundo
1890
Suministro de los primeros accionamientos para grúas de puertas y ascensores
1891
Puesta en servicio del primer transporte de energía en corriente trifásica
1902
Comienzo de la construcción de turbinas





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## *My Biggest Boner*

Some people, like myself, are lucky when we pull a boner. Instead of getting into serious trouble, we simply have a scare big enough to make us start thinking. That's just what happened to me recently.

I walked into a small cold-storage compartment in our plant and absentmindedly shut the door behind me. When I turned to leave, I found the latch broken so that I could not open the door from the inside.

Since the compartment was sealed completely against air leakage, I was really in a jam. It would be hours before anyone discovered I was locked in.

The only hole in my prison was a ½-in. tube used to discharge drip from the cooling coils. Thinking the matter over, I had an inspiration. I'd put my lips to the tube and exhale through it. Inhaling through my nose would, I thought, create a slight vacuum in the room and fresh air would leak in past the door gaskets.

This seemed to be my only hope. The air was getting stale and I was beginning to feel panicky. I paced up and down the small room and raged at my negligence. Then, instead of using the tube, I crouched in the far corner and jumped at the latch. I kicked it with all my strength and, to my surprise, it let go and I landed in the corridor.

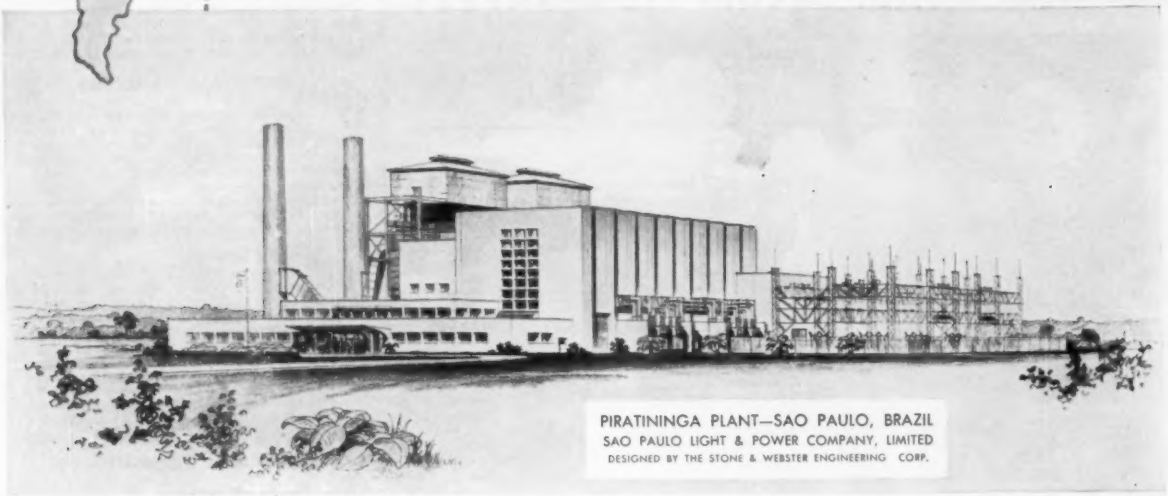
Since then I've had safety latches and lights installed on every air-tight compartment in our plant. I wasn't hurt, but I sure was scared.

ARTHUR HOLT

*Ocean Grove, N. J.*

• What is your "biggest boner"? We'll pay ten dollars for each one we publish.

# WORLD'S FASTEST-GROWING CITY INCREASES POWER OUTPUT BY 160,000 KW.



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SAO PAULO LIGHT & POWER COMPANY, LIMITED
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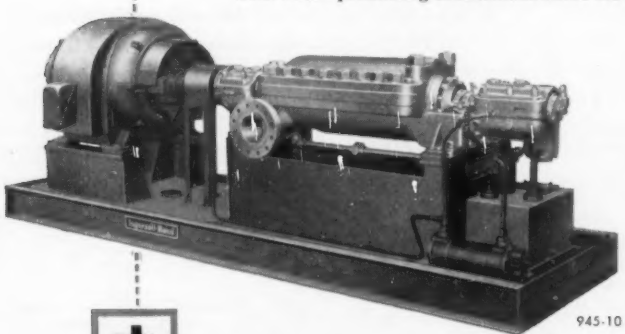
## *New São Paulo Steam Plant features ultra-modern equipment throughout... including six Ingersoll-Rand boiler feed pumps*

Latin America's biggest industrial community eagerly awaits completion of the new Piratininga Plant of the Sao Paulo Light and Power Company, Ltd., subsidiary of Brazilian Traction, Light and Power Company, Ltd. This 160,000 kw steam plant, under construction on the outskirts of Sao Paulo, will increase the Sao Paulo Company's present capacity by over 25%—promising substantial relief for an acute power shortage in the fast-growing Sao Paulo-Santos area.

The new station, designed by Stone and Webster Engineering Corp. and built by Stone and Webster Construction Co., will include three, 8-stage Ingersoll-Rand Class HMTA boiler feed pumps for each 80,000 kw generating unit. Each pump is rated at 1142 gpm, 371° F and 1190 psi. The HMTA design, featuring the modern Unit-Type rotor assembly, assures sustained high efficiency, trouble-free performance and exceptional ease of maintenance.

In addition to the boiler feed pumps, the Piratininga Plant will use seventeen other I-R pumps for miscellaneous services.

Whatever your pumping requirements, Ingersoll-Rand can supply the right unit for the job. Your nearest Ingersoll-Rand representative will be glad to give you prompt, intelligent assistance with your selection.



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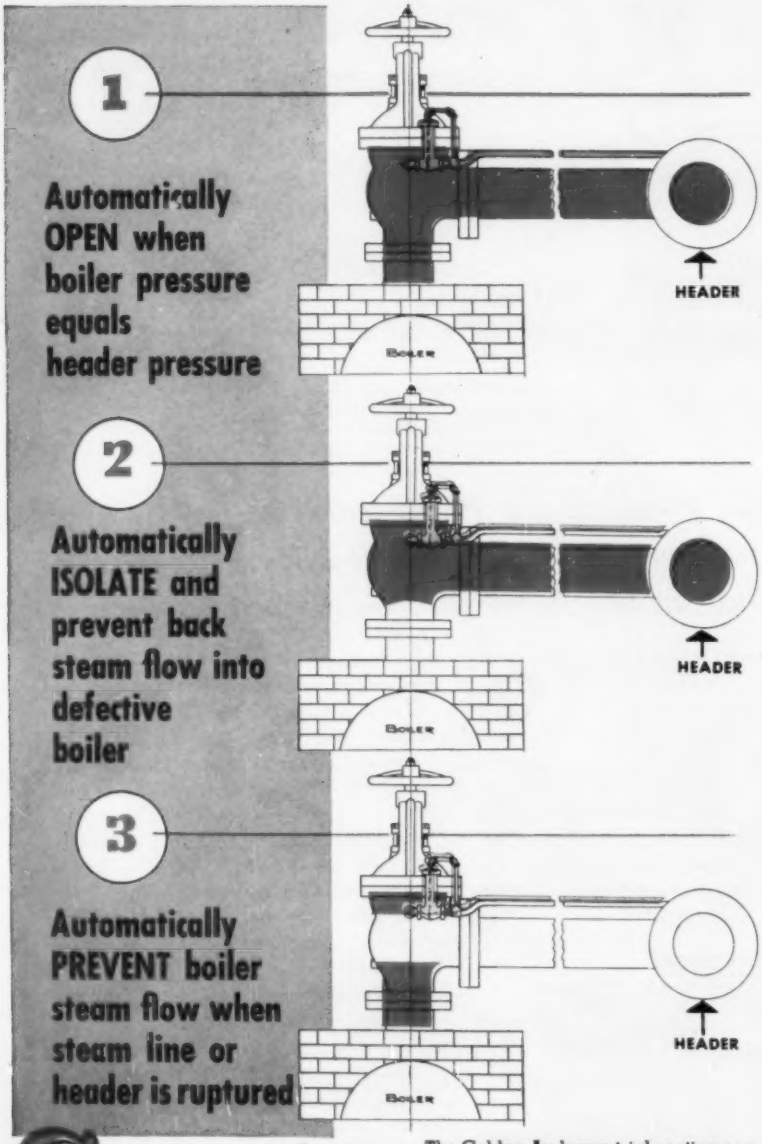


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*Begins on page 169*

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**24** **Precision-made,** scientifically-designed power transmission equipment. Bulletin 596, T B Woods Sons Co, Chambersburg, Pa.

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(*Continued on page 234*)

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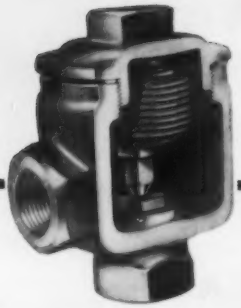

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Capacity 1900—11,650 lbs per hr. Pressures—5-200 psi.

Multiple trapping with Sterling will save you money.

*Write to*

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110 Business St., Hyde Park 36
BOSTON, MASS.

*Cut Piping Costs*

WITH ... **Babbitt** *Adjustable* SPROCKET RIM *with Chain Guide*

Save money! Lay out your overhead piping plan for utmost efficiency, convenience and economy — without special stairs, catwalks, balconies, or detours to floor level to bring valves within reach. Low-cost Babbitt Adjustable Sprocket Rim with Chain Guide makes every overhead valve easily accessible. Saves fuel and steam costs, too.

- **Simplifies pipe layouts**
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Four simple, quickly-assembled parts quickly installed—in range of 10 adjustable sizes to fit all valve wheels from 2 to 30 inches diameter, with rising or non-rising stems.

*Call your Industrial Distributor. He carries complete stocks. Or write for descriptive folder and prices.*

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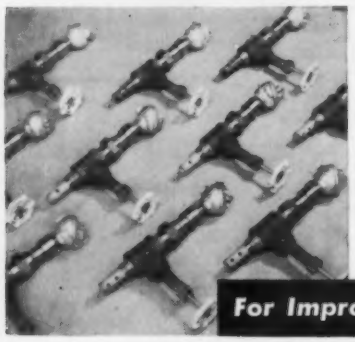
2 BABBITT SQUARE, NEW BEDFORD, MASS.



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***For Improved Accuracy and Reliability***

Industrial Instruments' thermistor-type automatic temperature compensating cells permit reliable, accurate recording, control and measurement of conductivity without the usual resettings of manual temperature compensators necessary with ordinary cells. The thermistor-type cell contains a temperature sensitive variable resistor which automatically compensates for temperature changes at the *point of measurement.*

Industrial Instruments supplies a complete line of recorders, controllers, indicators and conductivity cells. Write for catalog.

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## More FREE BULLETINS

*Begins on page 169*

**30** **Multi-point** circular chart recorders that keep six individual records on a single chart. Two-color, 4-page folder. Photos, construction features, full specs. Bulletin F-452M, Fielden Instrument Div, Robertshaw-Fulton Controls Co, 2920 N 4th St, Philadelphia 33, Pa.

**31** **Instruments** and gauges for measurement of combustion, draft, pressure, flow, vacuum, $CO_2$, smoke, velocity, static pressure, pressure differential, temperature, etc. Each type illustrated and described. F W Dwyer Mfg Co, 317 S Western Ave, Chicago 12, Ill.

### PIPING, VALVES, SPECIALTIES

**32** **Controlled closing** valves to counteract surge and water hammer problems. Illus, 6-page brochure. Full description, design characteristics, operation and supplemental uses. Simplex Valve & Meter Co, 68th & Upland St, Philadelphia 42, Pa.

**33** **Automatic shutoff** valves for protection of gauges and instruments in hydraulic or pneumatic systems. Two-color, illus leaflet. Full specs and installation details. Sprague Engrg & Sales Corp, 1144 W 135th St, Gardena, Calif.

**34** **Cartridge-type** hydraulic relief valves for 350 to 5000 psi applications. 4-page folder. Dimensional sketches, full data. Bulletin AD, Pantex Mfg Corp, Pawtucket, R. I.

**35** **Flexible metal hose** for all industrial purposes. 32-page booklet. Photos, cutaways, dimensional sketches, full specs and engrg data. Bulletin 130R, Flexonics Corp, 1301 S 3rd Ave, Maywood, Ill.

**36** **Wobble-rod** air valve for on-off control of pneumatic systems. Photos, dimensional sketches, full engrg data. Bulletin 61861, Pantex Mfg Corp, Pawtucket, R. I.

### PUMPS

**37** **Controlled capacity** pumps and liquid proportioning equipment. Two-color, 12-page booklet. Photos, cutaways, selection chart and full specs. Bulletin P-1153, Philadelphia Pump & Machy Co, Inc, Wynnewood, Pa.

**38** **Packaged chemical feed** systems including proportioning pumps, chemical tanks and auxiliaries, automatic control equipment. Two-color, 4-page folder. Photos, cutaways, diagrammatic sketches, full specs. Philadelphia Pump & Machy Co, Inc, Wynnewood, Pa.

### WELDING

**39** **Socket and butt** welding end dimensions for valves. Illus, 4-page folder. Bulletin 507, Edward Valves, Inc, East Chicago, Ind.

**40** **Stranded electrode** materials for *Aircomatic* welding. 12-page reprint from *Welding Journal.* Air Reduction Sales Co, 60 E 42nd St, New York 17, N. Y.

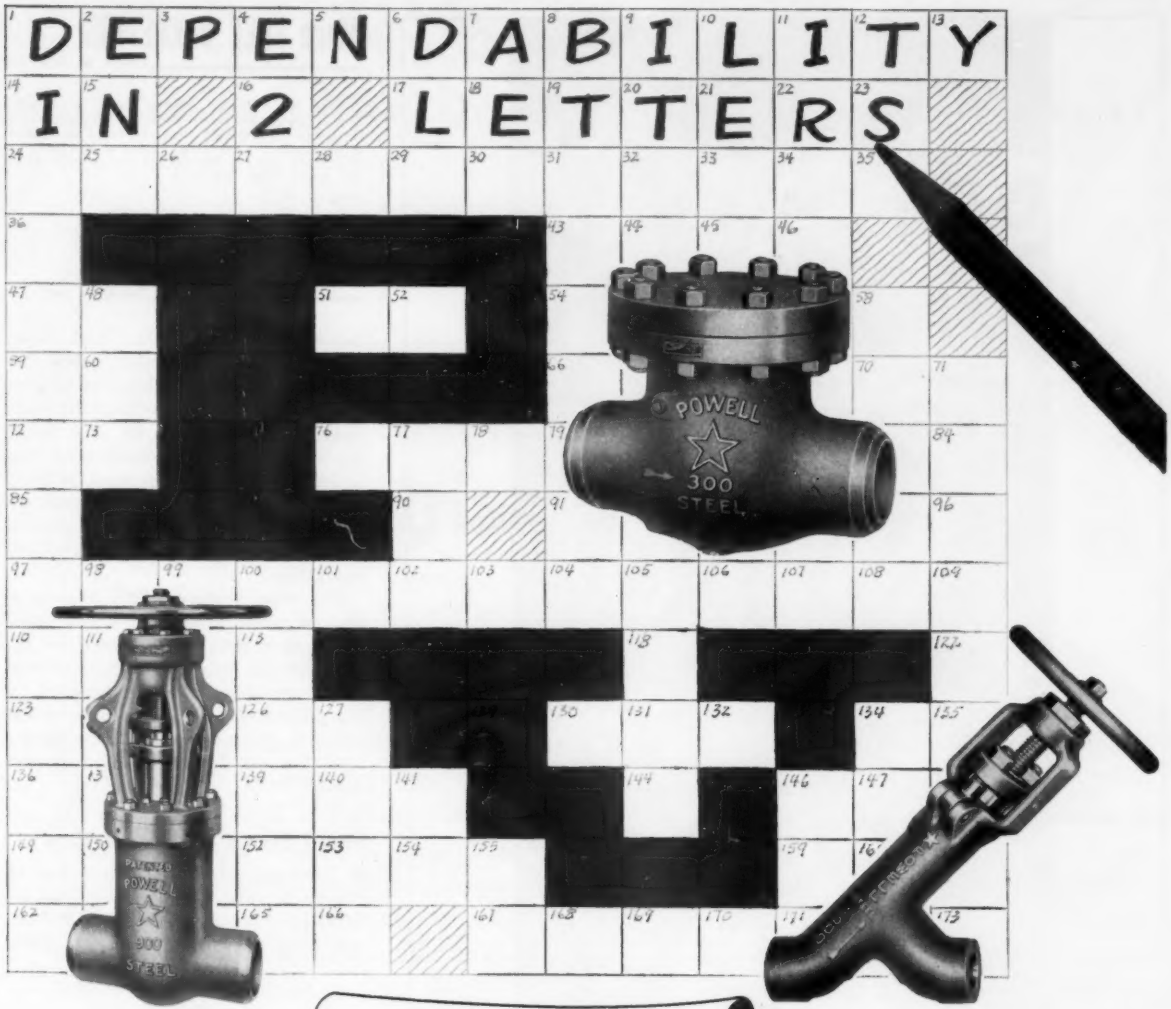
**41** **Pocket-size buyer's guide** to complete line of alloys and fluxes. 24-page booklet. All-State Welding Alloys Co, Inc, White Plains, N. Y.

**42** **Arc-welding** equipment including electrode holders, ground clamps, cable connectors and cable accessories. Two-color, 12-page catalog. Photos, full specs, price lists. Bulletin 9, Tweco Products Co, Boston at Mosley, Wichita 1, Kansas.

### WATER TREATMENT

**43** **Explanation** of fundamentals of ion exchange technology. Two-color, 16-page, illus booklet, titled *Amberlite Ion Exchange.* Rohm & Haas Co, Resinous Products Div, Washington Sq, Philadelphia 5, Pa.

**44** **Precipitators** for water softening, removal of turbidity, color, taste,




TOP

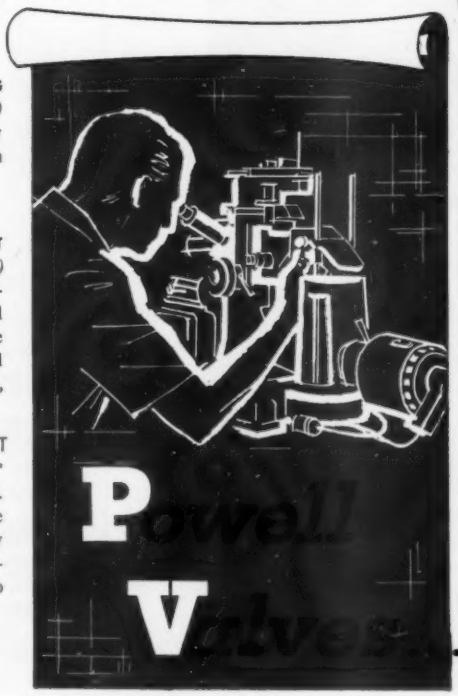
**WELDING END CAST STEEL SWING CHECK VALVE** *(Fig. 3061WE)* 300 pounds. Bolted flanged cap. Heavy rugged construction. Available in sizes 1" to 12", inclusive.

LEFT

**WELDING END PRESSURE SEAL CAST STEEL GATE VALVE** *(Fig. 19003WE)* 900-pound. Many proven advantages and exclusive features. Powell Pressure Seal Valves are available in Non-Return, Check, Globe, and Angle Patterns, 600 to 2500 pounds, inclusive.

RIGHT

**INTEGRAL BONNET CAST STEEL "Y" VALVE** *(Fig. 1314-A)* 1500-pound. Socket Weld Ends. The one-piece construction eliminates possibility of leakage between body and bonnet. Sizes ½" to 2", inclusive. Also available for 2500 pounds.




The life of a valve bears a certain relation to the life of the company that produces it. Powell has had a solid, oak-like growth for over a hundred years. That's only possible because The William Powell Company makes dependable valves.

Today, Powell Valves are proving their dependability in a greater variety of installations than any other valves in the world. And Powell is very likely the leader in research as well as development of special valves to overcome flow control problem situations.

All good reasons why PV, for Powell Valves, appears on more specifications year after year.

**THE WILLIAM POWELL COMPANY**
**CINCINNATI 22, OHIO**

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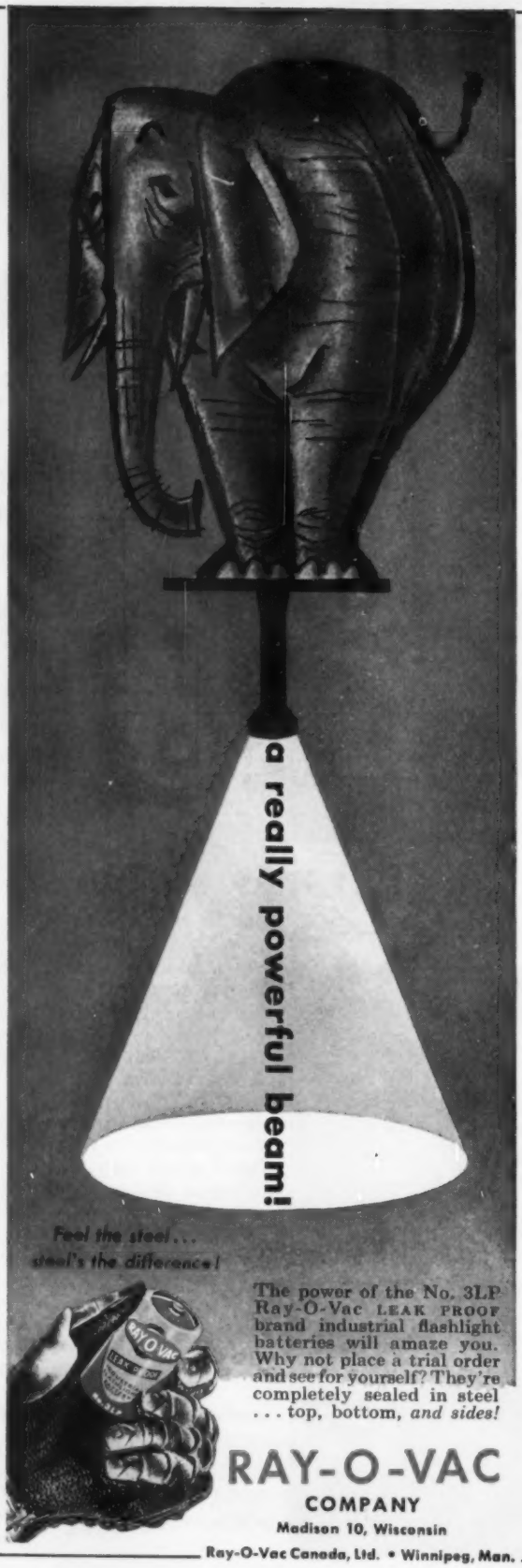
***..... 108th YEAR***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## More FREE BULLETINS

Begins on page 169

odor, alkalinity, silica and fluorides. Two-color, 20-page booklet. Application photos, cutaways, dimensional sketches, application and operation descriptions. Bulletin 2204B, Permutit Co, 330 W 42nd St, New York 36, N. Y.

## More POWER NEWS

Begins on page 154

get some of the power. Mark Kulp, state reclamation engineer, asked that "there should be an allocation of some energy to Idaho, which would be made available when it can be used inside the state." He also recommended that private capital be encouraged to build the two Clearwater dams with the understanding that the federal government pay the costs of flood control and navigation.

His other demands: "All appropriation of water should be made under Idaho state law; funds should be appropriated to recompense property owners for property taken or damaged by the projects and there should be recompense to governmental agencies for the loss of a tax base resulting from the dams."

### Noted Design Engineer Retires

► SARGENT & LUNDY, Chicago firm of consulting engineers, announces the retirement of its senior partner, Mr Ludwig Skog as of December 31, 1953.

Ludwig Skog

Born and educated in Norway, Mr Skog received his mechanical engineering degree from Trondheim Polytechnic Institute in 1909. He joined the staff of Sargent & Lundy in 1910 and became senior partner in 1947.

Mr Skog is widely known in engineering circles for his many contributions to electric power station design. His affiliations include a Fellowship in American Society of Mechanical Engineers and membership in American Society for Testing Materials and American Welding Society. He is also a member of the board of trustees of Illinois Institute of Technology and the

# No Room for Industrial Complacency

**Do you believe that American industry is equipped with remarkably up-to-date and efficient machinery? If you do, you are mistaken. The fact is that a large share of American industry's equipment is ancient, of obsolete design and incapable of attaining the efficiency that is made possible by modern production techniques.**

**This fact is documented by the Seventh Inventory of Metalworking Equipment, just completed by AMERICAN MACHINIST, a McGraw-Hill publication. In brief, AMERICAN MACHINIST shows that:**

**1. More than half (56%) of American industry's most basic production equipment—machine tools and metal-forming units—is overage, and much of it is so old that it has very limited usefulness.**

**2. Since Korea, the situation has become dangerously worse.**

### Facts vs. Plausible Theory

**These conclusions contradict the widely-held impression that America's industrial equipment is in better physical shape than ever before. The prevalence of this impression is not surprising. We, as a nation, have spent about $125 billion for new industrial plant and equipment since World War II. That is more than in any previous period in our history. During 1953, American industry invested $21 billion in new plant and equipment, an all-time high. From this, it would be reasonable to infer that our industrial plant and equipment must be in fine condition.**

**But the facts do not support that inference with respect to the machine tools and other metalworking equipment that are so crucial to our economy in war and peace. Here are the key findings of the AMERICAN MACHINIST Inventory:**

**(1) More than one million machine tools—out of a total of less than two million in the metalworking industries—are at least ten years old. Many of these, after day and night operation**

**during the war years and the recent rush to rearm, are actually much older production-wise than their age in years indicates. In most cases, these machines are unable to produce goods as efficiently as modern equipment can, thus needlessly increasing costs.**

**(2) Almost one out of five machine tools is more than twenty years old. Most of these machines are so outdated by modern standards that they have little more than scrap value. And an even larger portion of our metal-forming equipment (presses, brakes and shears, bending and straightening machines) has passed the 20-year mark and is beyond normal retirement age.**

**(3) Two out of three machine tools are of designs predating World War II, though many of them have been built since the war. Thus, two-thirds of our machine tools fail to incorporate the many major postwar improvements in design and operating methods.**

**(4) Never before has outmoded high-cost equipment been so widely diffused throughout American industry. In every one of fifteen major divisions of metalworking production, more than 45% of the machine tools are at least ten years old.**

**(5) Not since the depression days of the 1930's has the average age of machine tools risen so rapidly as it has in the past four years. Today, 55% are ten years old or older, compared with 43% just before Korea.**

### Quality vs. Quantity

Why has the condition of our metalworking equipment been steadily deteriorating since the end of World War II? Part of the explanation lies in the fact that, in the immediate postwar years, production of metalworking equipment lagged behind the production of industrial equipment generally. The larger part of the explanation, however, lies in the tremendous postwar expansion of the American economy. This expansion, which has more than doubled our total industrial capacity, has imposed requirements for metalworking machinery that have been met only by more extensive use of old and obsolete tools. In the critically important field of metalworking, the job of providing up-to-date tools is bigger than it ever has been.

There are those who argue that the time has come to cut back investment in new industrial plant and equipment and divert more of the national income into current consumption. They cite both the great increase in the nation's total industrial capacity since World War II and the fact that some industries now have more than ample producing capacity to meet their needs. But this type of calculation leaves out the *efficiency* of that producing capacity.

**The AMERICAN MACHINIST Inventory makes it manifest that in the key field of metalworking we are alarmingly short of first-rate, low-cost producing capacity. If we fail to remedy this situation by speeding the replacement of obsolete tools, it will be at the peril of our prosperity, at the peril of a sustained increase in our standard of living and of our national security.**

***McGraw-Hill Publishing Company, Inc.***

# ...They've added their FOURTH JOY WG-9 COMPRESSOR

Certain-teed's new Oklahoma paper mill uses compressed air in the manufacture of gypsum board papers. In addition, compressed air is used in general shop service, and it also furnishes the pressure for the ever-so-important automatic sprinkler system.

With such dependence upon air supply—24 hours a day—Certain-teed's engineers "bet on the Champ" and, for the fourth time in a row, specified a Joy WG-9 vertical compressor.

The WG-9 is a water-cooled, double-acting, single-stage compressor built to deliver medium amounts of air *constantly*. It, alone in its class, offers replaceable crosshead guides and cylinder liners, force-feed lubrication, and bearings that *never* need adjusting. As an extra bonus, "Dual-Cushion" valves are included to give higher valve capacity and better heat dissipation.

All-in-all, the WG-9 is a potent performer—able to take the measure of any compressor in its class. Get the specifications and check the record . . . you'll be convinced, too. Bulletin A-43 gives all data and will be sent upon request. ● ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

15 SIZES • 30 to 150 PSI • 172 to 881 CFM

**FOR OIL-FREE OPERATIONS WE OFFER THE WGO-9 SERIES**

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**for Vaneaxial Fans . . . Compressors, Vacuum Pumps and Boosters . . . Oxygen Generators**

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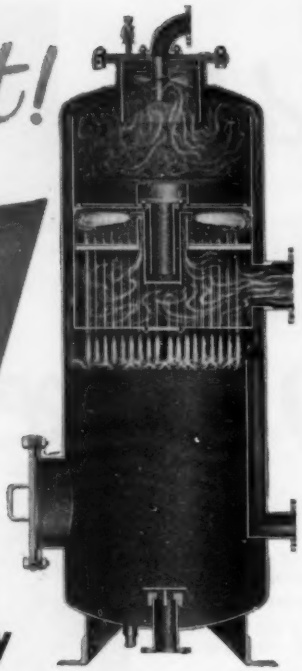

...gives you the *highest efficiency* in Tray Deaeration!

AMERICAN Jet-Tray Deaerators—the first new idea in deaeration in the past decade!—bring to industry for the first time the advantages of a combination of spray-type, direct-contact, first-stage heater, performing as an efficient direct-contact vent condenser, an efficient second-stage atomizer and a final deaeration section containing *more surface, more vapor and water turbulence than any other deaerator on the market today.*

AMERICAN Jet-Tray Deaerators *exclusively* use the high pressure of the incoming steam in indirect heat transfer with the tray deaerating process to increase the efficiency of the wetted-wall surfaces. The velocity of the incoming steam atomizes the preheated water from the first stage and also imposes a slight suction on the discharge from the interstage water seal. Since the degree of suction is always proportional to the resistance offered to the flow of steam, the seal remains stable and balanced under all conditions of varying steam flow, whether from varying load demands or inlet water temperature.

The third-stage tray section of the AMERICAN Jet-Tray Deaerator is made of stainless-steel tubing, with the individual tubes rolled into the stainless clad distributing tray . . . with this rugged AMERICAN construction there can be no possible failure resulting from intergranular corrosion, so often found in welded stainless-steel tray assemblies.

The exclusive AMERICAN Process of continually applying heat to the water undergoing final deaeration causes a continual boiling of water as it passes over the many wetted walls of the scrubbing towers, which greatly aids complete deaeration.

*Call or write today for complete information.*

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**AMERICAN** *Water Softener* **COMPANY**
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# More POWER NEWS

Begins on page 154

executive committee of Armour Research Foundation.

Mr A Kolflat has been appointed senior partner to succeed Mr Skog. He joined Sargent & Lundy in 1925.

## Water Treatment Executive Warns Against Corrosion

Costly air conditioning equipment can be reduced to junk in only two or three years by corrosion damage, according to H L Shuldener, president of Water Service Laboratories, Inc, of New York. Cooling water, circulated through cooling towers, evaporative condensers and air washers, is even more corrosive than ordinary water in that it repeatedly absorbs corrosive gases from the atmosphere as it is sprayed.

The problem of scale formation in hard water areas are as serious as in soft water areas, Shuldener continued. Scale deposits not only clog piping and nozzles, but also reduce efficiency of heat transfer surfaces. He emphasized that unavoidable leakage introduced corrosive make-up water even into the "closed" chilled water circulating systems for air conditioning.

## Volcanic Energy May Be New San Salvador Power Source

SAN SALVADOR is currently considering a survey and report on the possibilities of utilizing what is described as "volcanic energy" to produce electric power—and it is highly enthusiastic about the prospects. Negotiations are now underway with an Italian firm for the installation of a turbine generating unit some time next summer.

The project proposes using subterrannean steam that reaches the surface in the form of steady, high-pressure jets. The new installation will cost approximately $3-million and will produce 12,000 kw. Other Central American governments with expensive hydroelectric projects in their hip pockets are eyeing El Salvador's "volcanic energy" program with tremendous interest.

## U. S., Mexico Dedicate Cooperative Hydro Project

THE PRESIDENTS of the United States and Mexico, Dwight D Eisenhower and Adolfo Ruiz Cortines, recently dedicated the $47-million Falcon Dam project. One of the longest in the world, this 5-mile dam straddles the Rio Grande about 140 miles from the Gulf of Mexico. The dam itself is 26,300 ft long, 16,165 ft in Mexico and 10,135 ft in the United States. It has a spillway capable of handling 456,000-cfs of water. This

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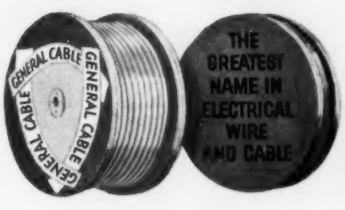


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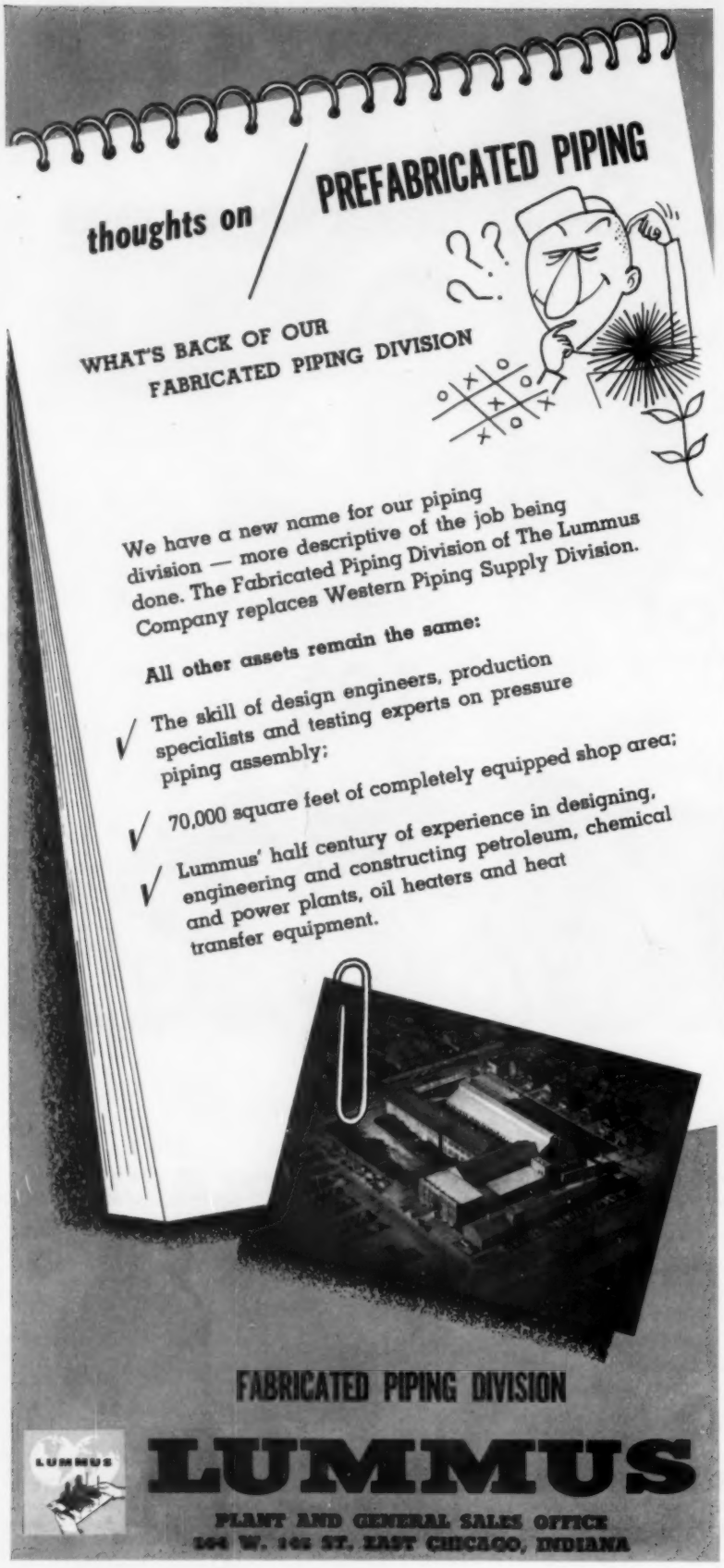
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WHAT'S BACK OF OUR
FABRICATED PIPING DIVISION
We have a new name for our piping division — more descriptive of the job being done. The Fabricated Piping Division of The Lummus Company replaces Western Piping Supply Division.
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## More POWER NEWS

Begins on page 154

whole project stands as a striking example of international cooperation—a relative rarity in today's world.

Of rock and earth-fill construction, the dam is 150 ft high, 1000 ft thick at the base and contains 13-million cu yd of material. The dam's 7x40 mile reservoir has a capacity of over 4-million acre-ft for flood control, river regulation, irrigation and power. Water from this artificial lake will irrigate over a million acres of arid land in both the U. S. and Mexico.

Two power plants, one built in each country as part of the project, have three vertical-shaft turbines apiece and are rated 14,750 hp at 100-ft head and 163.6 rpm. Each turbine drives an 11,667-kva, 0.90-pf, 6900-v generator. The two plants are expected to generate 250-million kwhr annually.

### New Burner Stimulates Anthracite Coal Consumption

NEW EFM FIRE-JET, a recent development in automatic firing equipment, promises to stimulate consumption of anthracite coal and bring new efficiency and economy in heating methods. The new burner is useful in converting steam and hot water boilers in large commercial and semi-industrial buildings to automatic firing.

Developed and manufactured by Electric Furnace-Man, Inc of Emmaus, Pa, the burner boosts original rated output capacity of existing boilers at least 15% and achieves unusually high combustion efficiencies. *Fire-Jet* derives its name from its myriad air jets—256 to the square foot of burner surface. Air forced through these injector jets supports combustion and assures complete and efficient burning of coal. The principle of the burner is over 20 years old, but this is the first time the unit has been put on a mass production basis and offered as separate equipment for conversion of existing boilers.

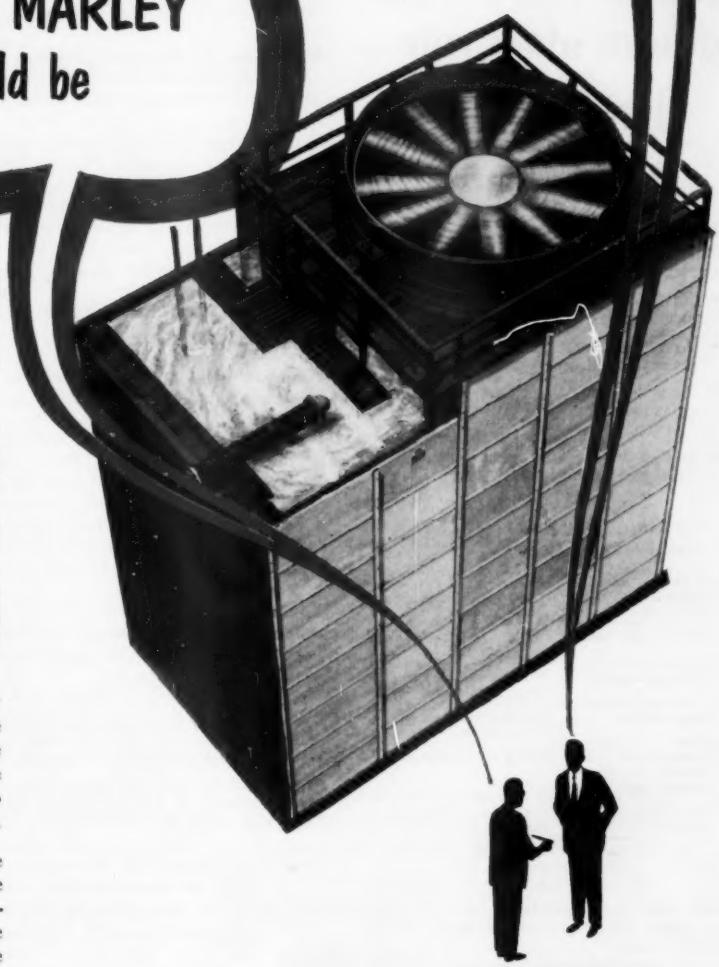
### Flyash and Concrete

PREPARATION OF A TENTATIVE specification for flyash as an admixture in concrete took a major step forward at the Fall Meeting of ASTM's Committee C-9 on Concrete and Concrete Aggregates at Purdue University. Changes incorporated in the new specification will necessitate rewriting *Test Method for Flyash as an Admixture for Portland Cement Concrete (C 311 - 53 T).*

*Significance of Tests of Concrete and Concrete Aggregates*, Special Technical Publication 22, sponsored by C-9 has been in high demand. The committee has now accepted a proposed outline

# What's the temperature of the basin water?

## 84°— just what MARLEY said it would be



Thermal control dictates the economy of every process operation, and the key to control is cold water — delivered consistently at design specification. Every Marley cooling tower offered today will produce that optimum result.

Built into every Marley tower is the pretested performance ability to do its specified job (or more) day-after-day, year-in-year-out. This is the result of 30 years of constant research and development; the result of 10,000 separate installations of Marley mechanical draft cooling towers. Today Marley has positive performance data for every tower for any location and Marley backs its knowledge with an equally positive guarantee.

Test after test have proved the efficiency of Marley rating methods. These tests have been conducted according to procedure specified by all accepted test codes. The Marley tower you purchase is subject to the same complete test after installation.

"Calculating Cooling Tower Performance from Test Data," a new Marley brochure explaining a simplified method of analyzing the actual performance of any type mechanical draft cooling tower will be available soon. May we have your name for an advance copy?

**The Marley Company**

Kansas City, Missouri

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## Follow this simple gauge glass rule...

**1 for the gauge**
**and**
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The small investment in space and pennies that you put into buying two spare gauge glasses will be repaid a hundred times in:

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| Normal Conditions (Up to 100 p.s.i.) | CORNING brand standard gauge glasses |
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| Higher pressures | PYREX brand heavy-wall gauge glasses |
| Extra visibility | PYREX brand red-line gauge glasses |
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| Lubrication inspection | PYREX brand lubricator glasses |
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Start this new protection today! Order two spare gauge glasses for every boiler in your plant!

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**Corning, New York**

*Corning means research in Glass*


# More POWER NEWS

Begins on page 154

for an entirely new edition that will be expanded to include significance of properties as well as tests of concrete and concrete agglomerates. Authors have been assigned and the project should be completed early in 1955.

### Seminars Bring Buyer to Product

Van Der Horst Corp of Olean, N. Y. recently instituted a series of customer seminars that bring the customer, as guest, to the scene of operation to see first hand how various products are produced. Each seminar, lasting two days, is fully programmed and includes only one customer at a time.

---

**Myers and Addington,** consulting engineers, has been dissolved as of August 1, 1953. To increase engineering facilities for their clients, David Moffat Myers and Michael Pope have joined the consulting firm of Seelye Stevenson Value & Knecht, 101 Park Ave, N. Y.

Myers has been in active practice as a consultant in industrial steam and power for more than forty years. His clientele includes a large number of leading manufacturing corporations both in this country and abroad. Pope has worked closely with Myers for the past seven years.

**National Association of Corrosion Engineers** has included in the technical program for its March 1954 meeting three educational lectures: *Fundamentals of Stress Corrosion* by J J Harwood, Office of Naval Research; *Fundamentals of Cathodic Protection* by R C Weast, Case Institute of Technology; *Design and Interpretation of Field and Service Corrosion Tests* by F L LaQue, International Nickel Co, Inc.

**Demonstration of latest techniques in welding** aluminum pressure vessels is a feature of new color film available from Aluminum Co of America. The 28-min, 16-mm film, *Welding Advances With Aluminum,* offers a comprehensive description of welding aluminum by both tungsten arc and consumable electrode methods. Requests for prints should be made on business letterhead to Motion Picture Section, 818 Alcoa Bldg, Pittsburgh 19, Pa.

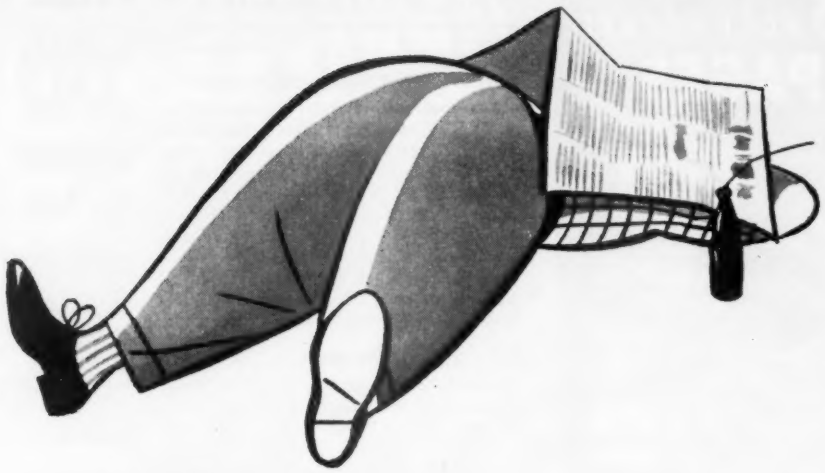
**Four Experiments in Hydraulics,** National Bureau of Standards film, is available on loan to groups having specific interest in hydraulics research. Experiments shown deal with damping of standing waves, dam-break waves, diffusion of jets and density currents. For information, write to Office of Scientific Publications, National Bureau of Standards, Washington 25, D. C.

**The Guy Behind Your Back** is a new sound slide-film that deals with safety in the operation of oxyacetylene torches and cutting machines. Copies of the film are available from any Airco office at $15 each.


This message from

**Power**

appeared recently in Business Week to remind management men throughout industry of the vast scope and key importance of power and of the men who direct the power services



# The men who invented the 5-day week

Once upon a time it took a man 5 hours to mine a ton of coal. *Today it takes about 1 hour.*

Once it took 20 hours and 48 minutes for the average man to earn one pair of shoes. *Today it takes 7 hours.*

What's changed, the men? Not much. The shoes? Only for the better.

The Work? Now you've said it. The work is just that much lighter, that much faster . . . thanks to *power.*

And who do you thank for power? Well here are several candidates.

You can thank your nearest valve manufacturer for making bigger and better valves to handle more and hotter steam to turn bigger and faster generators.

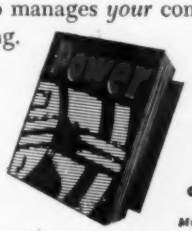
You can thank a number of instrument makers for taking the guess out of temperature or pressure and giving new safe ceilings for the boiler men to shoot for.

You can thank a whole society of engineers for courage and brains and imagination to design equipment thought impossible a generation back.

And you can thank the editors and pages of a magazine called POWER. It's had the skill and persistence and clarity to keep the power world advised, and on its toes, while all this progress was being made.

By all means, you can thank the power engineer, plant engineer, (or whatever title you use), who manages *your* company's power system and keeps your wheels all turning.

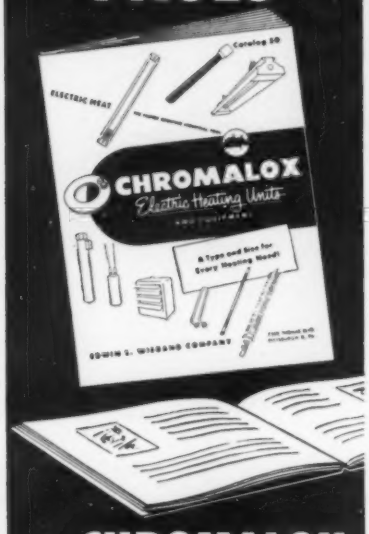
On a production schedule of 5 days a week.




***One of America's primary industrial media and a member of the Audit Bureau of Circulations***

McGRAW-HILL . . . ABP

# 48 FACT PACKED PAGES




on CHROMALOX *Electric* HEATERS

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You'll find an efficient and economical answer to your heating needs in Chromalox Catalog 50. It includes valuable application ideas and heat calculation data you'll find useful in your work. There are more than 15,000 standard Chromalox Units—most of them stocked for immediate application to your heating jobs.

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# APPOINTMENTS

## Corporation Executive Changes

**Minneapolis-Honeywell Regulator Co:** Paul B Wishart, president; Harold W Sweatt, chairman of the board succeeding Mark C Honeywell now honorary chairman. **Westinghouse Electric Corp:** Latham E Osborne, vice-president. **American Gas & Electric Service Corp:** Paul D Brooks, commercial vice-president. **Davis Engineering Corp:** A O Jaeckel, president. **Aeroquip Corp:** Matthew J Betley, vice-president and general manager.

## New Sales Managers

**Babcock & Wilcox Co:** George G Dyer, Cleveland district. **General Electric Co,** Carboloy Dept: C W Powell, Pittsburgh branch sales office; Alfred M Thomson, Cleveland headquarters of East-Central district; Harry H Jason, New England district; J D Kennedy, South-Central district; William S Baker, tool sales. **Leeds & Northrup Co:** Wilson D Trueblood Jr, Milwaukee office; Edwin A Yeo, Pittsburgh office; Willard H Neu, Cincinnati office.

**Norton Co:** William F Winemiller, engineering dept of refractories division. **Elliott Co:** Raymond V Thayer, Cincinnati district. **Darling Valve & Mfg Co:** M Stuart Evans, Eastern Regional sales. **Cleaver-Brooks Co:** James M Sturman, Escher Wyss division. **Reliance Electric & Engrg Co:** Wilmer K Schlotterbeck, Buffalo district; Antony C Schettler, Baltimore branch; C V Gregory, district sales.

## Purchases, Mergers, Etc

**Vitro Mfg Co** will merge with Vitro Corp of America and Vitro Chemical Co, two subsidiaries. **American Brake Shoe Co** has purchased the welding machinery business of Leader Welding & Mfg Co of Berkeley, Calif.

## Recent Moves

**Bailey Meter Co:** Boston district office now at 230 Congress St, Boston 10, Mass. **Dravo Corp,** Machinery Division: Cleveland office now at 4207 Chester Ave, Cleveland 3, Ohio. **National Research Corp:** all parts of Equipment Division now at 160 Charleton St, Newton Highlands 61, Mass.

## Institute Elections

**National Association of Corrosion Engineers:** Kempton H Roll of Lead Industries Assn, chairman of North East Region; Edward G Brink of American Viscose Corp, vice-chairman; Edwin J Titsworth of Koppers Co, Inc, secretary-treasurer. **Material Handling Institute, Inc:** Charles B Elledge of General Electric Co, president.

## Obituaries

**Walter B Templeton,** 81, founder of Templeton, Kenly & Co of Broadview, Illinois, Dec 6.

**Ames Bartlett Hettrick,** 49, executive of American Cyanamid Co.


# FREE CATALOG!

available to you who are interested in the facts on open steel flooring.

Up to the minute information on the hows and whys of construction and installation of Tri-Lok Open Steel Flooring may now be at your finger-tips. Here is a four-page catalog designed to aid you in selecting the best types and styles of open-steel flooring for your particular construction project.

**In This Catalog You'll Find**

- Tables of Safe Loads
- Specifications required for open steel flooring installation
- Types of Tri-Lok Open Steel Flooring available
- Information concerning construction, sizes, strength and adaptability of Tri-Lok Steel Flooring

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*National Distributor for THE TRI-LOK CO.*

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please be sure to let us know promptly. It takes time to correct the stencil addressing plate. And we don't want you to miss copies of POWER.

**Also . . . . . .**

be sure to give us *both*

**(1) your OLD address**

***and***

**(2) your NEW address.**

We need them *both* to make the change *—also confirmation of your company connection and position.*

**POWER**

330 W. 42d St., New York 36, N. Y.

# AUTOMATIC CONTROL EQUIPMENT

ENGINEERED DESIGN BY HAMMEL-DAHL

## "ALL OUT PRODUCTION"

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**HAMMEL-DAHL "KNOW HOW"**

to solve your

*Control Valve Problem*

**FLO-TESTED***
**DIAPHRAGM CONTROL VALVE**
**3000 SERIES**

These Standard Control Valves are designed for use with air operated instruments for control of pressure, temperature, liquid level, rate of flow, humidity or pH. They can be applied with equal efficiency on air, water, steam, oil, gas or chemical service and are available in sizes from ½" to 12".

The ALLSTEEL Superstructure is fabricated from 3/16" steel stampings. Oilite Bearings eliminate spring stem friction. Stainless steel spring stem standard. Packing box bolted on all size valves. Bonnets and blind heads are forged fabricated. Bonnet will support ALLSTEEL Superstructure if installed horizontally. They are through-bolted for greater strength and also to provide simplicity of field reversal. All valve plugs are top and bottom guided in hardened stainless steel bushings. Valve action reversible in the field, requiring no additional parts.

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## HAMMEL-DAHL COMPANY

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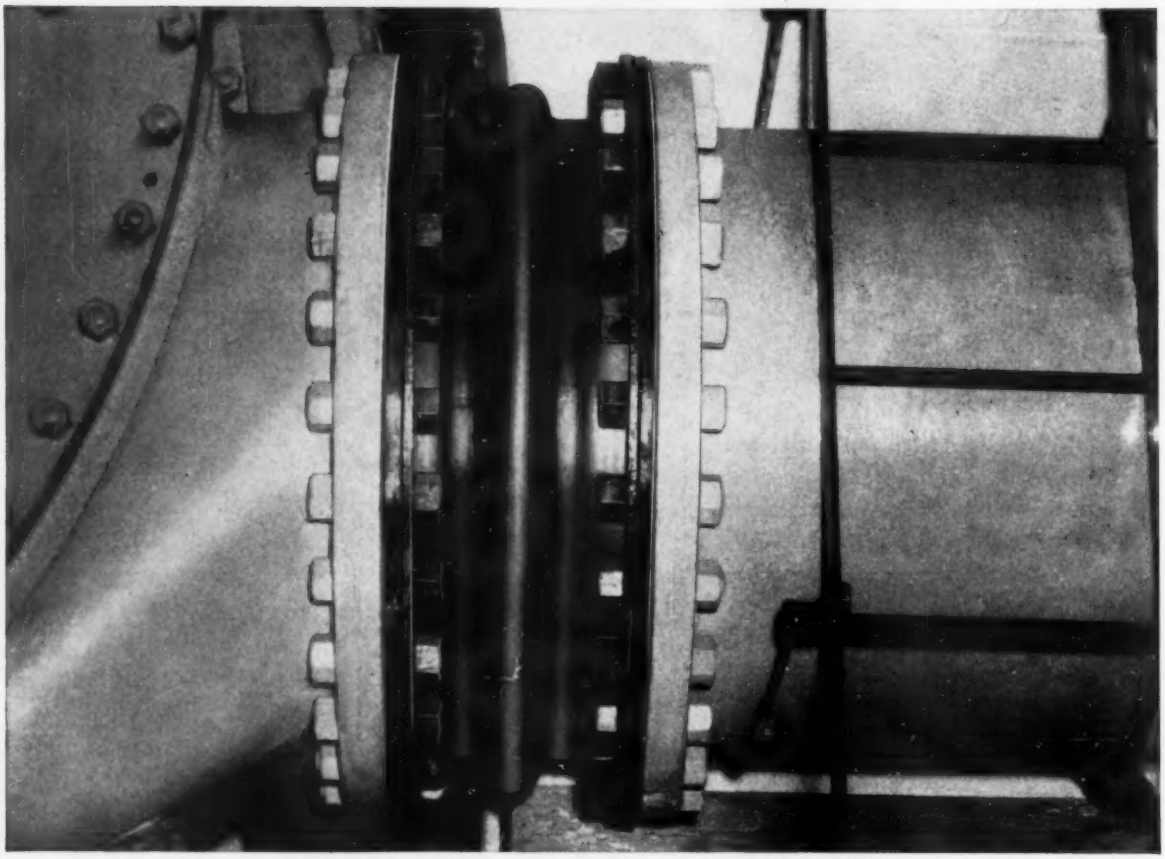
SALES OFFICES IN ALL PRINCIPAL CITIES

MANUFACTURING PLANTS IN WARWICK, R. I., U. S. A., CANADA, ENGLAND, FRANCE AND HOLLAND

# 28 years old... but there's a lot of life in the old joint!



Back in 1926, this 30" x 12" U.S. Expansion Joint was installed in a Louisiana power plant. This rubber joint is still in fine working condition. Age has not impaired its efficiency. Three other U.S. Joints in this plant are the same age, are still performing well... and one of them has been used continuously in the valve end inlet header water circulation line in a *very moist location.* Our service engineers report it has many more years of fine service still ahead!

In United States Rubber Company's Expansion Joint Line are standard types to meet the majority of general industrial requirements on pressure or vacuum lines—insulating against vibration, compensating for expansion or contraction. Joints can also be designed and built to meet your own specifications. You can always rely on U.S. Expansion Joints to lengthen the life of equipment, save many times their original cost.

Get in touch with any of United States Rubber Company's 25 strategically located District Sales Offices, each staffed with engineers to serve you, or write to address below.

U.S. RUBBER
SERVING THROUGH SCIENCE

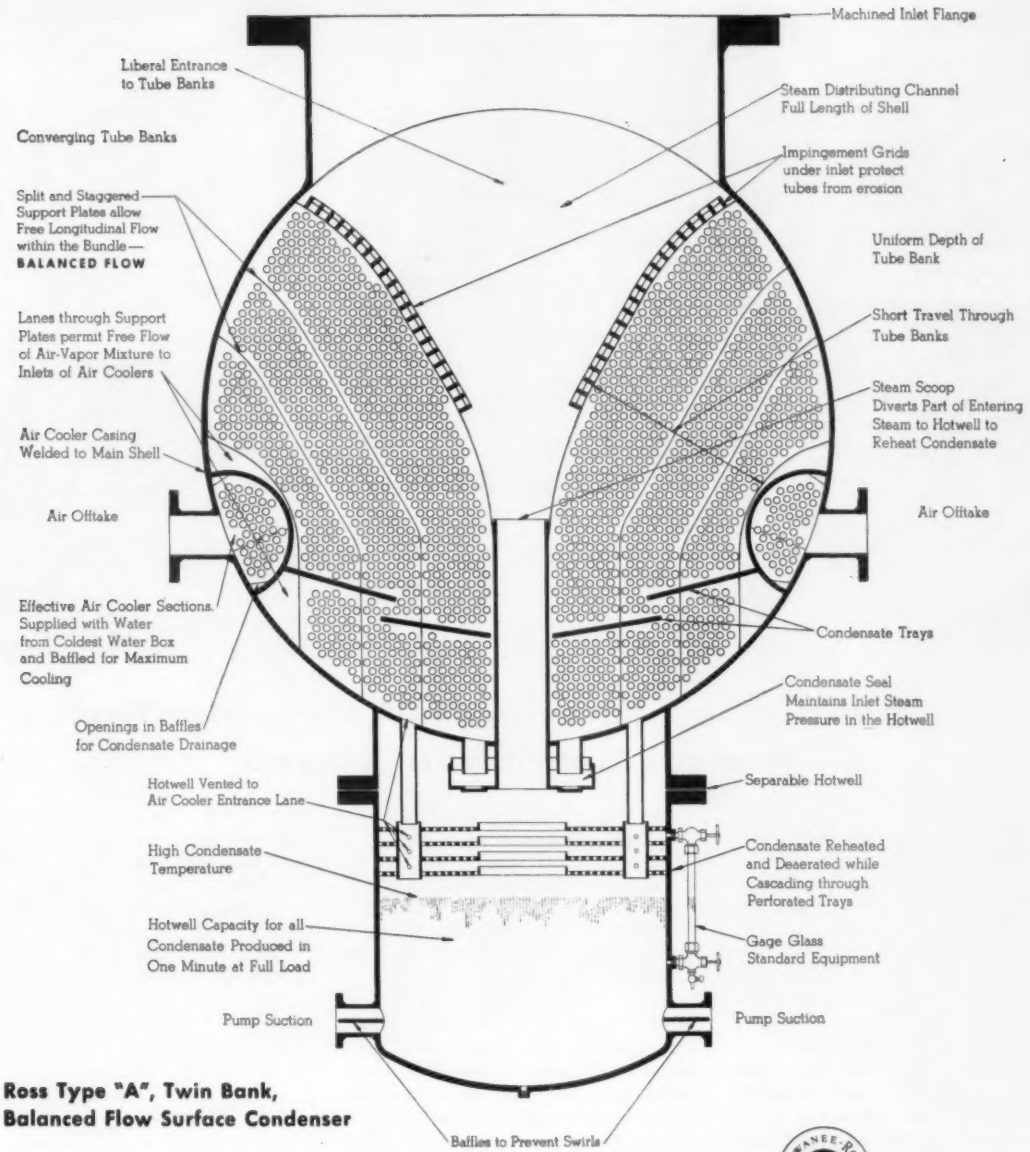
*"U.S." Research perfects it*
*"U.S." Production builds it*
*U.S. Industry depends on it*

**UNITED STATES RUBBER COMPANY**

**MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.**

**Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting**

# Design features that make Ross Surface Condensers A SOUND INVESTMENT


Machined Inlet Flange
Liberal Entrance to Tube Banks
Steam Distributing Channel Full Length of Shell
Converging Tube Banks
Impingement Grids under inlet protect tubes from erosion
Split and Staggered Support Plates allow Free Longitudinal Flow within the Bundle— BALANCED FLOW
Uniform Depth of Tube Bank
Lanes through Support Plates permit Free Flow of Air-Vapor Mixture to Inlets of Air Coolers
Short Travel Through Tube Banks
Steam Scoop Diverts Part of Entering Steam to Hotwell to Reheat Condensate
Air Cooler Casing Welded to Main Shell
Air Offtake
Air Offtake
Effective Air Cooler Sections Supplied with Water from Coldest Water Box and Baffled for Maximum Cooling
Condensate Trays
Condensate Seal Maintains Inlet Steam Pressure in the Hotwell
Openings in Baffles for Condensate Drainage
Hotwell Vented to Air Cooler Entrance Lane
Separable Hotwell
High Condensate Temperature
Condensate Reheated and Deaerated while Cascading through Perforated Trays
Hotwell Capacity for all Condensate Produced in One Minute at Full Load
Gage Glass Standard Equipment
Pump Suction
Pump Suction
Baffles to Prevent Swirls

**Ross Type "A", Twin Bank, Balanced Flow Surface Condenser**

The facts and figures on Ross Surface Condensers are impressive. It will be time well spent to have a Kewanee-Ross representative tell you *all* about the design features and distinct advantages of this truly modern line.

Long a leader in the field, the originator of such noteworthy developments as all-welded steel surface condenser construction, Kewanee-Ross is in a key position to meet your requirements *exactly* with standardized or special, large or moderate size, or packaged units.

For the complete story—at your desk—write today.

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# It's a good thing for you that Mrs. MacTavish was on the school board

The plans for the new school building were all completed and were now being shown to the Board.

"And why," asked Mrs. MacTavish, "should the new building burn oil instead of coal?"

"Well," explained the architect very patiently, "oil saves labor."

"So does a stoker!" snapped Mrs. MacTavish.

"And oil is clean."

"No cleaner than coal if you use the right grade and burn it right. What's more, you can always get coal and maybe you can't get oil. Remember how the schools over at Jamestown had to shut down for weeks at a time during the war because they couldn't get oil?"

"Anything else, Mrs. MacT?"

"Indeed there is. I always save my big reason till the last. Coal's a sight cheaper."

"Oh now, Mrs. MacT., I don't think there is so much difference."

"When it comes to spending money, I don't want to think – I want to know. The Chesapeake and Ohio Railway has a combustion engineering service – absolutely free, mind you. Let's get their man to come in and give us facts – not opinions."

The C&O combustion engineer's carefully documented survey proved beyond doubt that coal would not only save several thousand dollars a year in fuel cost, but that the installation itself would be cheaper.

"There should be a Scot on every civic board," snapped Mrs. MacTavish. "We're the only people left who seem to care a hoot about the taxpayer's pocketbook."

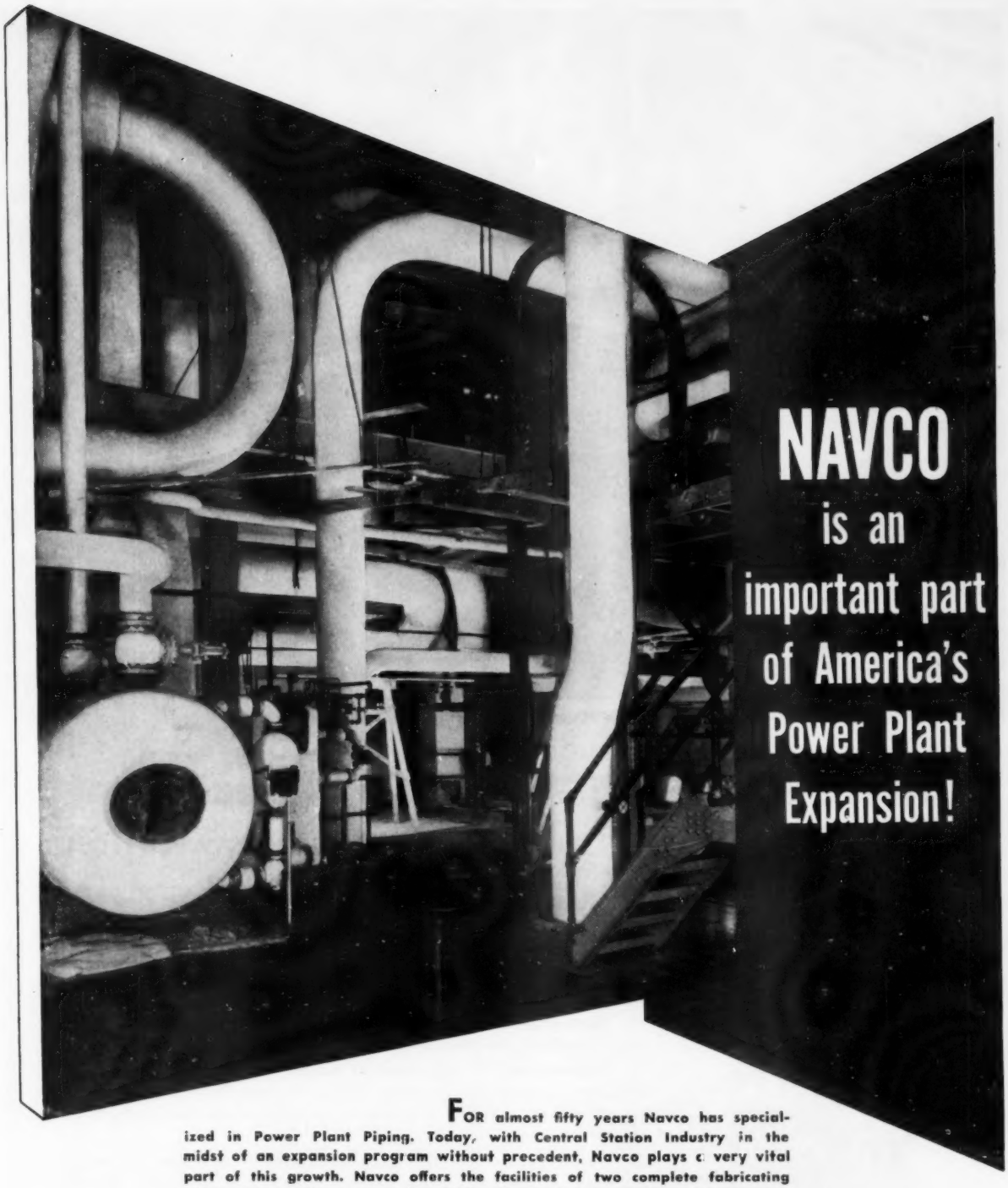
**Chesapeake and Ohio Railway**

**COAL...FUEL OF THE FUTURE**

***Bring your fuel problems to C & O***

As the world's largest carrier of bituminous coal, the C&O is intimately familiar with every phase of coal use. We have a large staff of experts who will gladly help you to locate the coal best suited to your needs; to help you use it most efficiently; to help get it to you promptly.

*Write to:*
Coal Traffic Department
Chesapeake and Ohio Railway
2115 Terminal Tower
Cleveland 1, Ohio



# NAVCO is an important part of America's Power Plant Expansion!

**FOR almost fifty years Navco has specialized in Power Plant Piping. Today, with Central Station Industry in the midst of an expansion program without precedent, Navco plays a very vital part of this growth. Navco offers the facilities of two complete fabricating plants, one of the most modern Piping Research Laboratories in the country and a large Construction Department manned by personnel experienced in all phases of High Temperature Power Plant Piping.**

NAVCO

## NAVCO PIPING

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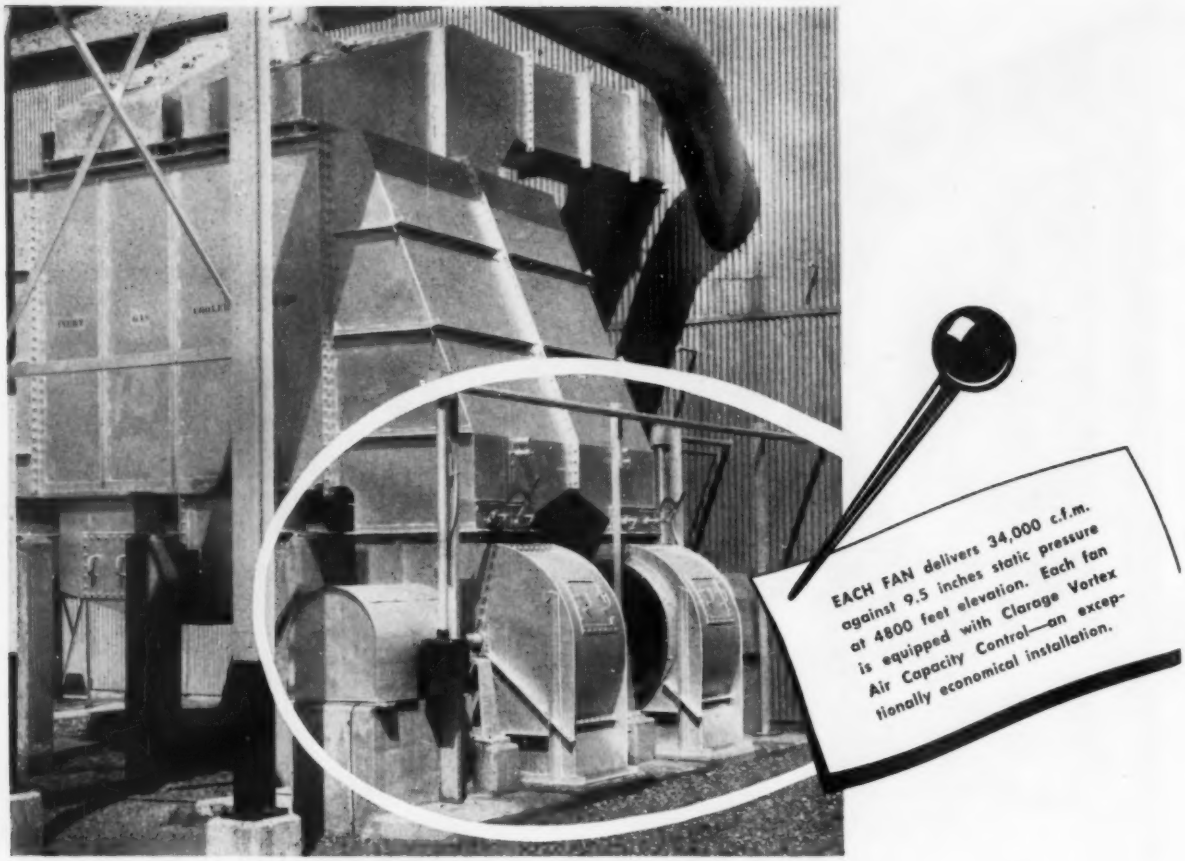

EACH FAN delivers 34,000 c.f.m. against 9.5 inches static pressure at 4800 feet elevation. Each fan is equipped with Clarage Vortex Air Capacity Control—an exceptionally economical installation.

# Where Fan PERFORMANCE is Important

## AS IN THIS FORCED DRAFT INSTALLATION

# the Wise Choice is CLARAGE

**Another Clarage installation out-of-doors!** The two Type W Fans shown above furnish forced draft to boilers in the field processing plant of the Stanolind Oil and Gas Company, Powell, Wyoming.

Through winter's cold and summer's heat, these fans must give round-the-clock, uninterrupted service.

**Unprotected fan equipment to function properly must be good!** From past experience over many years, the consulting engineers and the boiler people KNEW that they could recommend Clarage without reservation.

Yes, regardless of operating conditions—indoors or out—**you can RELY on Clarage Fans** to provide economical service for a long time to come.

***VALUABLE DATA:*** **The secrets of Clarage superiority are fully explained in this Service Manual—78 pages on your BEST BUY in air handling equipment. Write for copy today.**

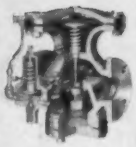
**You can Rely on...**

# CLARAGE

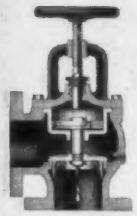
*Headquarters for Air Handling and Conditioning Equipment*

SALES ENGINEERING OFFICES IN ALL PRINCIPAL CITIES • IN CANADA: Canada Fans, Ltd., 4285 Richelieu St., Montreal

6 OF THE MANY McALEAR CONTROL GUARDSMEN

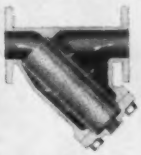


Pilot-operated pressure reducing valve for accurate control of reduced pressures . . . single seated closed valve affording dead end service.

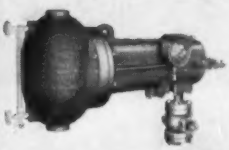


Stop and check control—used with two or more boilers—automatic safeguard against reverse steam flow.

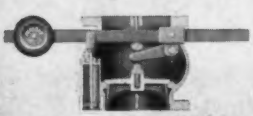
Suction and pressure type strainer—clamped or bolted cover—adaptable to any strainer service.



Self-cleaning "Y" strainer — used to protect regulators, pumps and traps by removing foreign matter from the line.



Feed water regulator—used for continuous feed to boiler to maintain water level. Has mercury cut-out switch as additional safeguard in case of low water.



Back pressure valve—Single seated vertical type . . . efficient—noiseless. Operates with condensing and non-condensing engines.

# You can forget control problems if you REMEMBER McALEAR

There's a safe way to forget all about your control problems—just remember McALEAR. For when you use McALEAR controls you benefit from a background of fifty years of experience covering every type of installation. You know you have controls engineered to an exactness . . . controls that are just right for the specific job. You can depend on McALEAR because (1) There is an expert engineering service behind every product, (2) McALEAR sales representatives are hand picked for control know-how; (3) McALEAR controls are available through leading plumbing and heating wholesalers.

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PRESSURE · FLOW · LIQUID LEVEL · TEMPERATURE
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for STEAM, WATER, AIR, OIL-GAS

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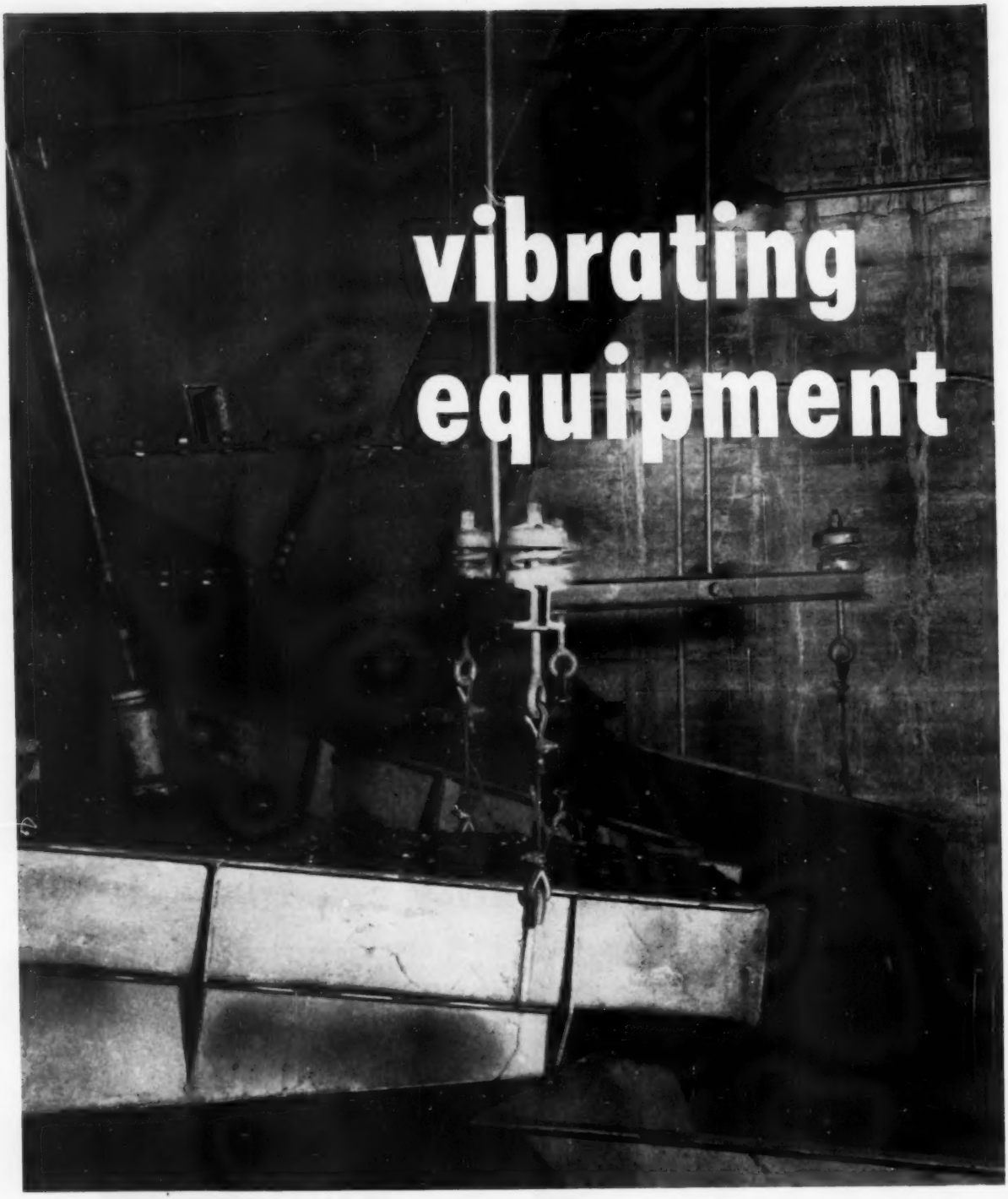


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**IF IT'S MINED, PROCESSED OR MOVED**

***. . .IT'S A JOB FOR JEFFREY!***

# Choice of 7 Case Designs

## WHEN YOU SPECIFY

# ASHCROFT DURAGAUGES

**SPECIFIC NEEDS** are your best guide in selecting a pressure gauge casing. Ashcroft Duragauge Casings, made in three distinctly different types of material and seven different designs, meet practically every installation and service requirement:

**ALUMALIFE®**—a special aluminum alloy that is light, strong and has excellent overall resistance to corrosion and vibration.

**CAST IRON** — tough and durable. Used in corrosive conditions where aluminum would not be suitable.

**PHENOL** — light, strong, rigid plastic that is acid-proof and corrosion-proof.

Every Duragauge case is dust and moisture-proof, and the entire gauge system can be easily removed from the case *as a unit.*

To insure peak performance and maximum service life in specific installations, you can choose an Ashcroft Duragauge with the Bourdon Tube made of any one of eight different types of materials. All provide unusually long tip travel, consequently greater accuracy of indication is assured. The patented Nylon Movement outwears all others. And the micrometer adjustment pointer is easy to get at and reset precisely while on the shaft.

Remember, only Ashcroft Duragauges give you all these advantages. So — ask the nearby Ashcroft Distributor to help you choose Duragauges that fit your needs exactly.

**ASHCROFT DURAGAUGE CASE MATERIALS, MOUNTING AND DIAL SIZES**

| CASE | BACK FLANGE | MOUNTING | | CONNECTION | | DIAL SIZE |
|---|---|---|---|---|---|---|
| | | WALL | FLUSH | LOWER | BACK | |
| Black Alumalife® with flat, threaded Alumalife ring | Yes | Yes | Yes | Yes | Yes | 4½", 6" |
| Black Cast Iron with flat, threaded ring of Alumalife on 4½" and 6" and Bronze on 8½", 10" and 12" | Yes | Yes | Yes | Yes | Yes | 4½", 6" 8½", 10", 12" |
| Black Phenol Turret with snap ring | No | Yes | Yes | Yes | Yes | 4½", 6", 8½" |
| Black Phenol with threaded phenol ring. Safety blowout disc is standard | Yes | Yes | No | Yes | Yes | 4½", 6", 8½" |
| Black Alumalife with special ring held tightly at top by a hinge pin and at bottom by a clamp screw | No | No | Yes | No | Yes | 4½", 6", 8½" |
| Black Cast Iron with special ring held tightly at top by a hinge pin and at bottom by a clamp screw | No | No | Yes | No | Yes | 4½", 6", 8½" 10", 12" |
| Black Alumalife with black clamp slip ring | Yes | Yes | No | Yes | No | 4½", 6" |

**YOUR INDUSTRIAL SUPPLY DISTRIBUTOR** is as close as your telephone. Long experience in serving industry makes him fully qualified to meet your needs exactly and economically.

# ASHCROFT GAUGES

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'HANCOCK' VALVES, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, 'AMERICAN' INDUSTRIAL INSTRUMENTS, AIRCRAFT PRODUCTS. BUILDERS OF "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES.

### QUENCHED NUT

The Bethlehem Quenched Nut is no ordinary nut, but is definitely superior in every way. It is made from 0.40 to 0.50 carbon steel, and is forged and extruded in a forming die, then quenched and tempered. This manufacturing procedure permits the nut to develop the full strength of any stud or bolt with which it may be used.

### CONTINUOUS-THREAD STUD

Here's the big reason why the Bethlehem Continuous-Thread Stud resists premature fatigue failure—there's no point of thread run-out anywhere on the stud. Therefore severe stresses cannot hit at any one point. Instead, they are effectively distributed along the stud's working length. The stud is made from carbon or alloy steels, and comes plain or heat-treated.

# Bolting Trio Resists Fatigue Failure..Minimizes Down-Time

The three fasteners shown above are ideal for operations involving high temperatures or high pressures, or both. This is because of the effective battle they put up against premature fatigue failure.

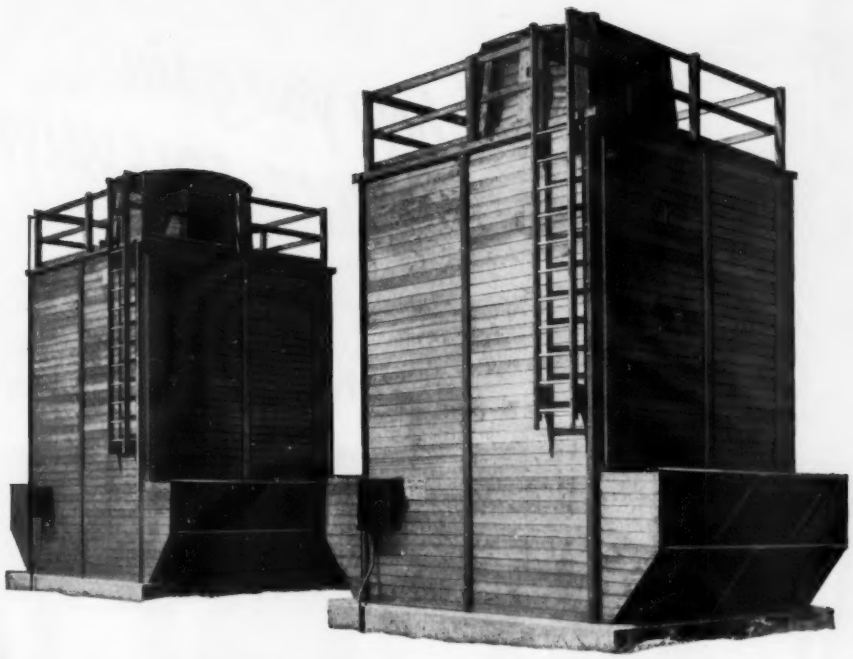
The trio, consisting of the Bethlehem Continuous-Thread Stud and two Bethlehem Quenched Nuts, have the ability to stay on the job for long periods of time. They minimize down-time, and thus effect worthwhile operating economies.

Both the Bethlehem Continuous-Thread Stud and the Quenched Nut are made in a range of sizes so wide as to meet virtually every need. If you'd like to discuss their use with a Bethlehem representative, drop a line to the nearest Bethlehem office.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL



# MORE EFFICIENCY MEANS MORE POWER

Improved efficiency in every detail of the operation of power generating facilities is one answer to the ever-increasing demands for more power.

That's why leaders in the power field choose Pritchard cooling towers. They know that Pritchard heavy-duty towers—like these shown here built for the diesel power plant in Nebraska City, Nebraska—are designed *right* . . . engineered with adequate capacity . . . to do any required cooling job at minimum operating expense. Consult Pritchard—a founder member of the Cooling Tower Institute—to be sure you get *guaranteed performance . . . maximum efficiency* . . . from your next cooling tower.

## Pritchard QUINTAIR* Air-Cooled Heat Exchangers

For more efficient . . . more dependable . . . cooling or condensing of liquids, gases or vapors, specify a Pritchard QUINTAIR* air-cooled heat exchanger. Quality construction assures long, trouble-free service . . . skillful design makes all parts that may require attention readily accessible for easy maintenance.

*Registered Trade Name*

*Industry's Partner for Progress*

Cooling Towers
Specialized Heat Exchangers
Gas and Air Treating Equipment
Construction and Processing Facilities

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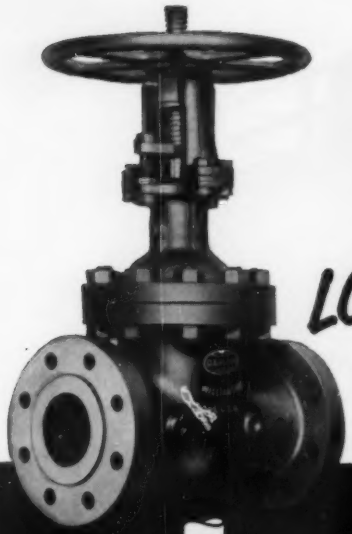
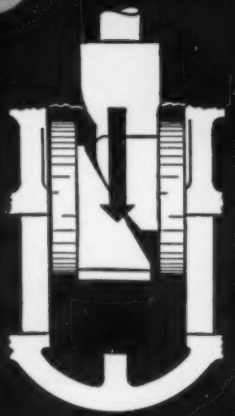
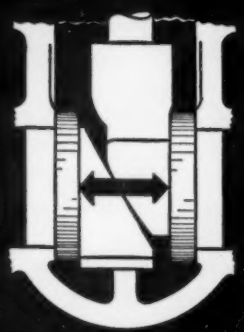


# Look how you gain LONGER, TROUBLE-FREE VALVE LIFE

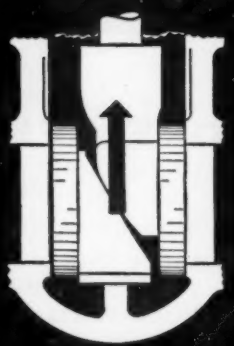
## with Darling revolving disc gate valves*



**DESCENDING.** Fully revolving discs, independently hung, change seating position at each closing, assuring uniform wear distribution for prolonged service. Plain "no pocket" discs are interchangeable for *extra* life!



**CLOSED.** Faces of upper wedge are radiused and faces of both wedges are transversely beveled for equalized wedging pressure and *tight closing despite valve body distortion.*



**RISING.** Wedging pressure on both discs is released before discs start to rise. Complete absence of wedging pressure during travel of discs assures easy operation, tight closing and greatly prolonged valve life!

***DARLING REVOLVING DISC GATE VALVES FOR EVERY NEED...**

These unique valves are available in iron, bronze, steel, special corrosion-resistant alloys and combinations, and in a broad range of sizes, for all kinds of normal and unusual services in pressures up to 1500 pounds. Before you buy gate valves of *any* type, find out what you stand to gain by using the proper Darling valves. Simply outline your service requirements and ask for a free, descriptive bulletin.

## DARLING VALVE & MANUFACTURING CO.

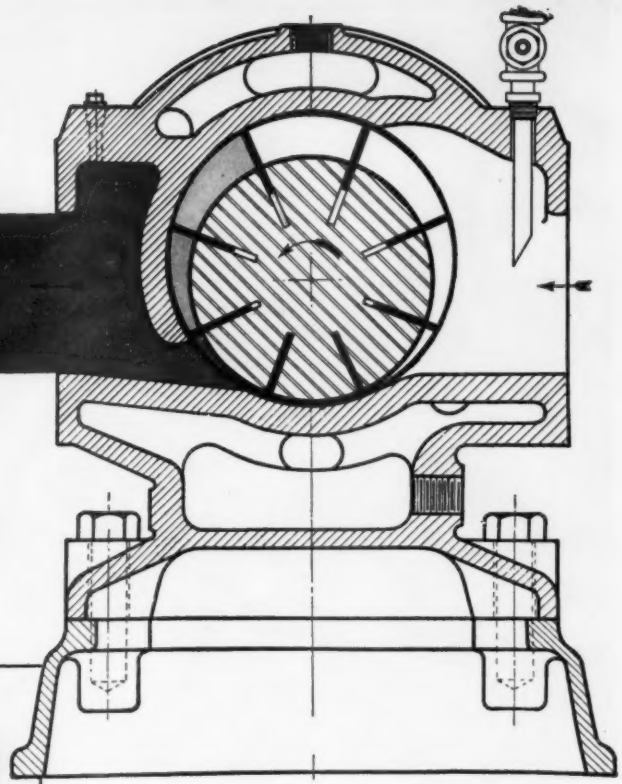
**Williamsport 8, Pa.**

*Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario.*

DARLING TRADE DARLING MARK VALVES

**FOR PLUS VALUES, JOB-PROVED AGAIN AND AGAIN**

# putting the [redacted] on compression costs



Check your needs for •••• *Engine Starting Air* • *Pneumatic Power*
*Pneumatic Controls*
*Refrigerant Compression* • *General Plant Air*
*Instrument Air* • *Air Lifts*

When you consider all the many uses you have for compressors—consider the best way to get compression with dependability, and minimum cost and attention.

Fuller Rotary Compressors have so many inherent advantages that they warrant your closest examination. Free from reciprocating parts, with no valves to leak or seats to grind, no unbalanced forces to set up vibration. Fuller Rotary Compressors assure low-cost, smooth-flow operation during their long life.

Check your own compressed-air needs and send this check list to Fuller. A Fuller engineer will give you the *right* recommendation to save you money. Write now to Fuller Company, Catasauqua, Penna.

**Fuller**

**Pioneers of high-efficiency vane-type rotary compressors**

**FULLER COMPANY**
**Catasauqua, Pa.**

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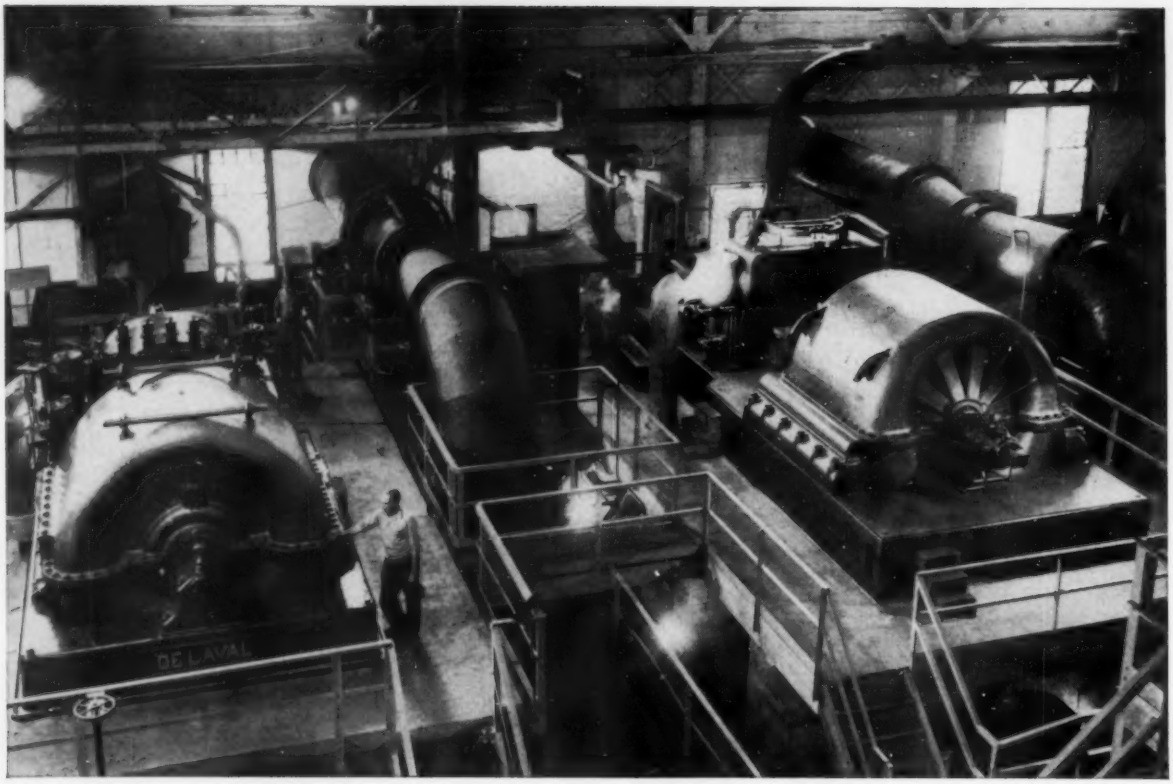



# SECOND TURBO-BLOWER FOR SHARON STEEL—BY DRAVO

Twenty-five years ago, Dravo Corporation furnished the Sharon Steel Corporation's Roemer Works the first blast-furnace turbo-blower ever built by DeLaval Steam Turbine Company. Just recently installed by Dravo and now in service beside the original unit is a second turbo-blower of the same capacity. Both are 7,000-hp units, capable of delivering 60,000 cu ft of air per minute at 30 lb per sq in.

Dravo often serves as a "construction department" for utilities and industry . . . building complete power stations, boiler plants, water pumping stations, pipe-line facilities and water or waste treatment plants . . . on a single contract basis.

For more than 60 years Dravo has served business and industry in many fields of engineering activity. Why not inquire today as to how Dravo can be of service to you?

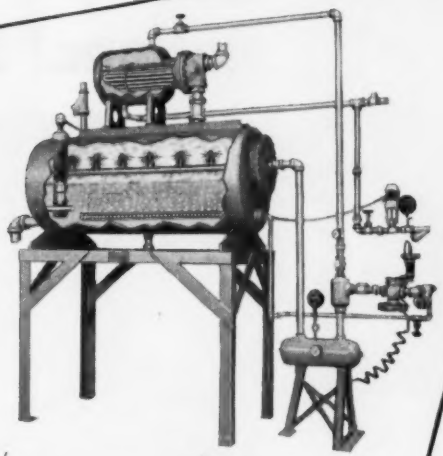
Write or call, Construction Department, Dravo Corporation, Fifth and Liberty Avenues, Pittsburgh 22, Pennsylvania.

**THIS *too* IS DRAVO**

Air conditioning · boiler and power plants · bridge sub-structures · compressor and pumping stations · crane cab coolers · docks, locks and dams · dredging · gantry and floating cranes · industrial foundations · marine repairs · open steel flooring · ore and coal bridges and unloaders · pipe prefabrication and erection · pump houses and intakes · ready-mixed concrete · river sand and gravel · river transportation · slopes, shafts and tunnels · space heaters · steel shipping containers · towboats and barges · water and waste treatment plants · DRAVO

# A FRESH LOOK INTO *Deaeration!*

## SCHAUB ZERO-OXYGEN *Deaerators*

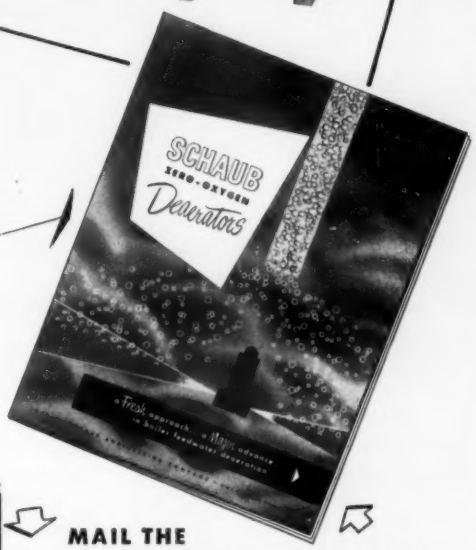


# ENTIRELY NEW

***in operating principle***

***in mechanical design***

***in the advantages they offer***




"Newness" for its own sake is no advantage in a deaerator. But when new thinking achieves improved performance not possible with conventional designs, it's worth looking into!

The Schaub Zero-Oxygen Deaerator differs from all others in that it provides *external* pre-heating to a temperature *above* boiling point, with over-atmospheric pressure held only up to the internal sprayer manifold. The storage receiver itself is *fully vented* and operates at constant, safe atmospheric pressure.

This simple but basic difference opens the way to a whole series of better performance characteristics, including:

**LOW OPERATING COSTS**
**LOW MAINTENANCE COSTS**
**COMPLETE OXYGEN REMOVAL—(to .005 cc/liter)**
**COMPLETE SAFETY**
**WIDE RANGE FOR LOAD VARIATIONS**
**SIMPLER DESIGN AND OPERATION**

The "hows" and "whys" of Schaub Zero-Oxygen Deaerators make an important story for any engineer or operating man concerned with boiler feedwater deaeration. Mail the coupon and we'll send it to you.

**FRED H. SCHAUB ENGINEERING COMPANY**
**2105 South Marshall Boulevard • Chicago 23, Illinois**

### MAIL THE COUPON FOR BULLETIN 575

Why a deaerating system? How can it save you money and trouble? What makes a good system? How to get maximum benefits at lowest cost? What are some of the engineering factors involved?

These and many other questions are answered in Schaub Bulletin 575, just off the press. It's a valuable contribution to boiler deaeration theory and practice.

**FRED H. SCHAUB ENGINEERING COMPANY**
**2105 South Marshall Boulevard Chicago 23, Illinois**

Please send me, without cost or obligation, my personal copy of your new Bulletin 575 on Boiler Feedwater Deaeration.

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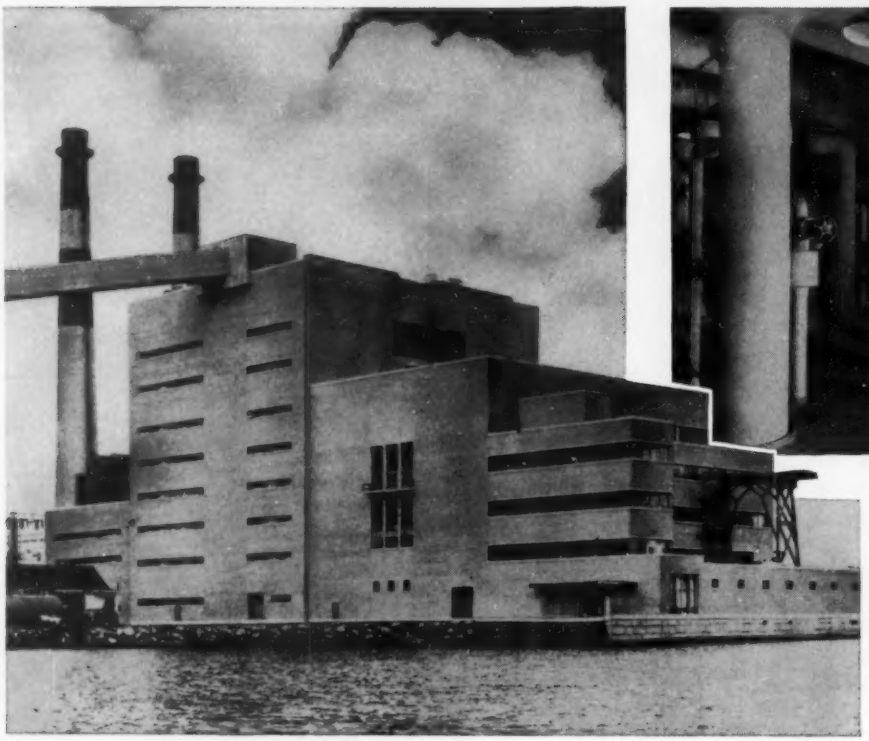
# New England's most modern Power Station used 25 miles of National Seamless Pipe



A VIEW OF the boiler feed pump discharge piping which feeds the water heaters in turbo-generator Unit #1. Further uses for NATIONAL Seamless in this plant are: Bleeder Steam Suction, Condensate, Heater Drain and Vents, City Water and Fire Protection, Oil Piping, Soot Blower and Boiler Blow Down.

OVER 700 tons of U·S·S NATIONAL Seamless Pipe and Tubes, ranging from ¾" ID to 18" OD, were used in constructing this $30,000,000 power station at Salem Harbor, Massachusetts.

Construction of the Salem Harbor Station of New England Electric System was begun in December, 1948. The first of the huge turbo-generators went into operation in late 1951. The completion of the second unit gave the plant a capacity of 150,000 kilowatts and a combined annual output of more than 1,000,000,000 kilowatt hours.

The boilers operate on oil or coal. Steam for conversion to power is generated at 1450 psi pressure and 1000°F. temperature. To condense the steam, the plant uses 175,000 gallons of ocean water *per minute* or 250,000,000 gallons per day!

This type of grueling service demands the best in power plant piping. U·S·S NATIONAL Seamless has never been surpassed for power plant service, even under the most severe operating conditions. Because they are pierced from solid billets of steel, NATIONAL Seamless Pipe and Tubes have the strength, uniformity, and dependability of solid forgings—remain structurally sound under high temperatures and intense pressures.

For further information on NATIONAL Seamless applications in power plants, write for free Bulletins 10 and 26. And when you're planning a new plant or repiping a present installation, play it safe with NATIONAL Seamless.

NATIONAL TUBE DIVISION, UNITED STATES STEEL CORPORATION, PITTSBURGH, PA.

COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO, PACIFIC COAST DISTRIBUTORS

UNITED STATES STEEL EXPORT COMPANY, NEW YORK

## U·S·S NATIONAL Seamless PIPE AND TUBES

4-271

UNITED STATES STEEL

**CHIEF ENGINEER WILLIAM NOTE** inspects the original Leslie Temperature Pilot taken from heater for its first overhaul. Leslie Representatives Frank Riggio (*left*) and Bob Gentner (*right*) look on.

**DEWITT O. HESSLER,** Laundry's President, joins Chief Note in examination of the original Leslie Pilot before reinstallation.

# HOW SHOULD A 21-YEAR-OLD BEHAVE?

## Temperature Pilot leads flawless life for 21 years prior to its recent, initial overhaul

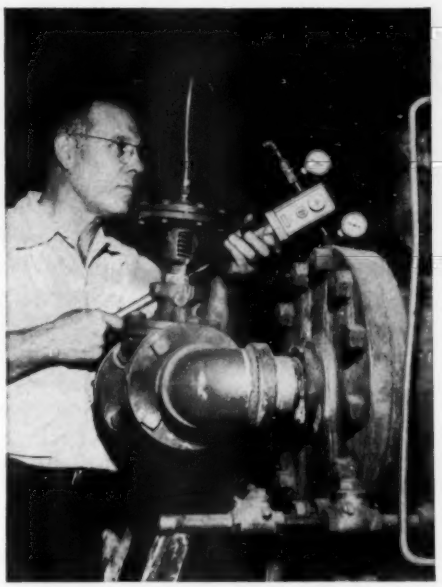
A 21-year-old Leslie Temperature Control Pilot had its "coming-out-party" recently at the Hessler Laundry, Paterson, N. J. The very first one of its kind ever made, it was installed at the Hessler plant back in 1933 by the firm's chief engineer, Bill Note—who also ordered the pilot's first overhaul in 21 years of continuous service.

The pilot was designed to control constant process temperature over extended periods without necessity for recalibration or replacement of thermal elements. The Hessler field test worked out so well that the pilot was left untouched after its initial setting, for 21 years.

Periodic inspections showed the pilot was doing the job without appreciable wear or need for *any* attention. This year, it was removed from the heater for a complete examination and after a quick clean-up, it was put right back into service.

### Top performance suggests other applications

The outstanding behavior of this first pilot is being repeated today by Leslie Pilots in hundreds of other applications in all industries. The wide adjustable ranges (32°-400°F and 300°-600°F) make the pilots adaptable to most operating conditions. The fast-responding bi-metallic element responds to changes as small as ¼°F.



**CHIEF NOTE REINSTALLS PILOT** after *no-cost* overhaul. Parts showed no appreciable wear or corrosion after 21 years of continuous hot water heater service.

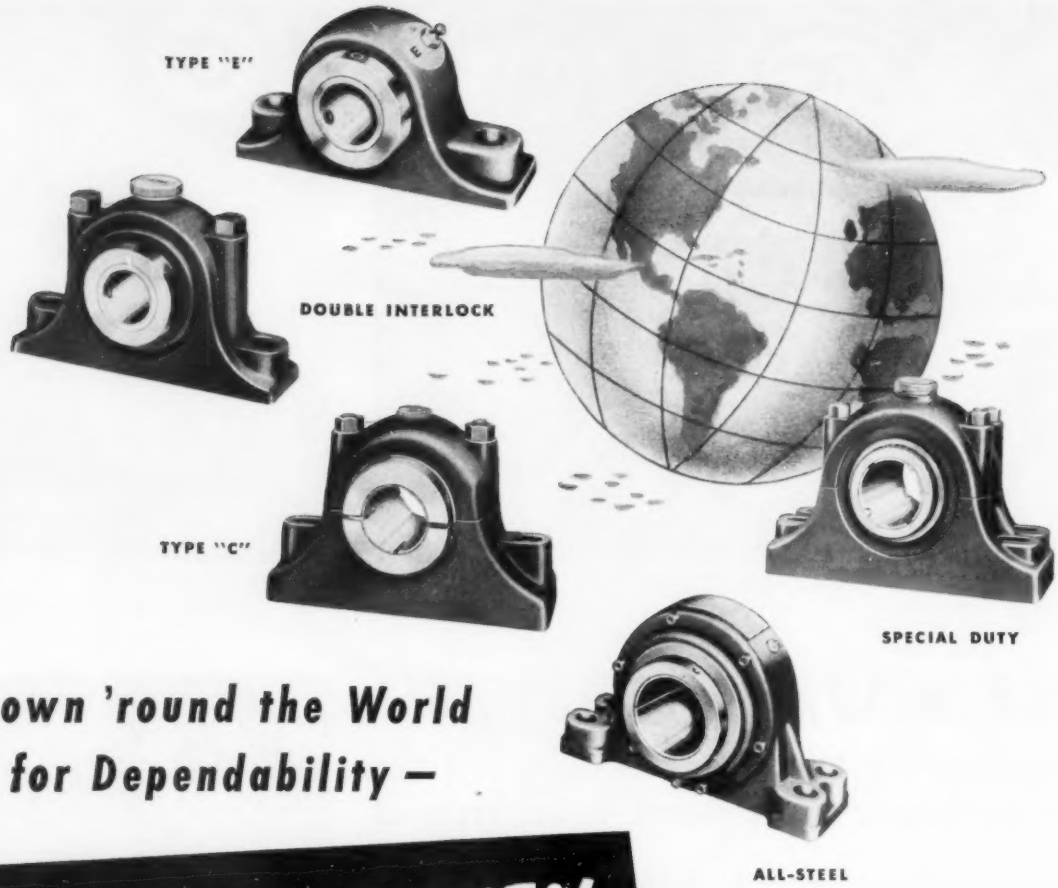
**Send for Technical Data Sheet 464-14 describing Leslie Temperature Pilots and Controllers.**

TRADE LESLIE MARK

**TOPS IN QUALITY PRESSURE LEVEL AND TEMPERATURE CONTROLS**

*Since 1900*

**LESLIE CO.** 235 Grant Avenue, Lyndhurst, New Jersey




## *Known 'round the World for Dependability —*

# DODGE-TIMKEN

★ In millions of installations Dodge-Timken bearings have proved their ability to cut costs and increase production. Their dependability is unquestioned under every condition of service. Available in five different types, including the new Dodge-Timken All-Steel Pillow Block for grueling, heavy duty jobs. All are sealed both on and off the shaft.

Dodge-Timken bearings are fully assembled and lubricated — ready to lock on the shaft. They are normally available from distributors' stocks . . . in a wide range of sizes. Call your distributor or write us for Dodge-Timken bulletins.

**DODGE MANUFACTURING CORPORATION**
**3200 UNION STREET, MISHAWAKA, INDIANA**

**DODGE**
*of Mishawaka, Ind.*

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***CALL THE TRANSMISSIONEER,*** your local Dodge Distributor. Factory-trained by Dodge, he can give you valuable assistance on new, cost-saving methods. Look for his name under "Power Transmission Machinery" in your classified telephone book.

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**FOR YOUR NAME PLATE REQUIREMENTS, WRITE OUR SUBSIDIARY, CHICAGO THRIFT-ETCHING CORPORATION, 1555 N. SHEFFIELD AVENUE, CHICAGO 22, ILLINOIS**

# Actual Figures... *NOT Claims*

# Prove that AMERICAN "WC" coal crushers are top performers at low operating costs!

## CRUSHING FACTS

based on User-Reports from 12 Power Plants & Coal Mines

Total Tonnage Crushed:
**1,507,827 tons**

Parts Replacement Cost:
**$0.0028 per ton**

When the actual tonnage figures (as supplied by the Chief Engineers of power plants and the Preparation Engineers of coal mines) are compared with the total cost of replacement parts ordered, the real story of the quality and efficiency of American "WC" Coal Crushers is apparent—the story given in the panel above.

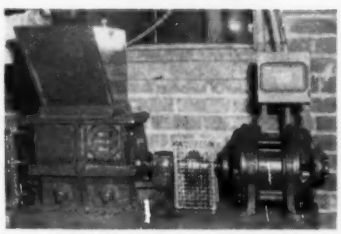
With American, quality is not a mere claim, nor even an isolated performance story. It is based on the consistent pattern of high-tonnage-at-low-maintenance for *all types* of American coal crushers—a record directly traceable to the efficient crushing action of the American-originated rolling-ring crushing principle, plus a half century of specialized experience in building coal crushers.

American "WC's" are designed for capacities up to 90 tons per hour . . . but whether your requirements range from coal sampling up to 600 tons or more per hour, American has the crusher to handle your job at the lowest possible cost.

**WRITE FOR COMPLETE INFORMATION AND LITERATURE**

**. . . and for low-cost coal sample crushing**

Model 9-9 American Laboratory Crusher, one of several sizes for reducing coal samples prior to analysis.

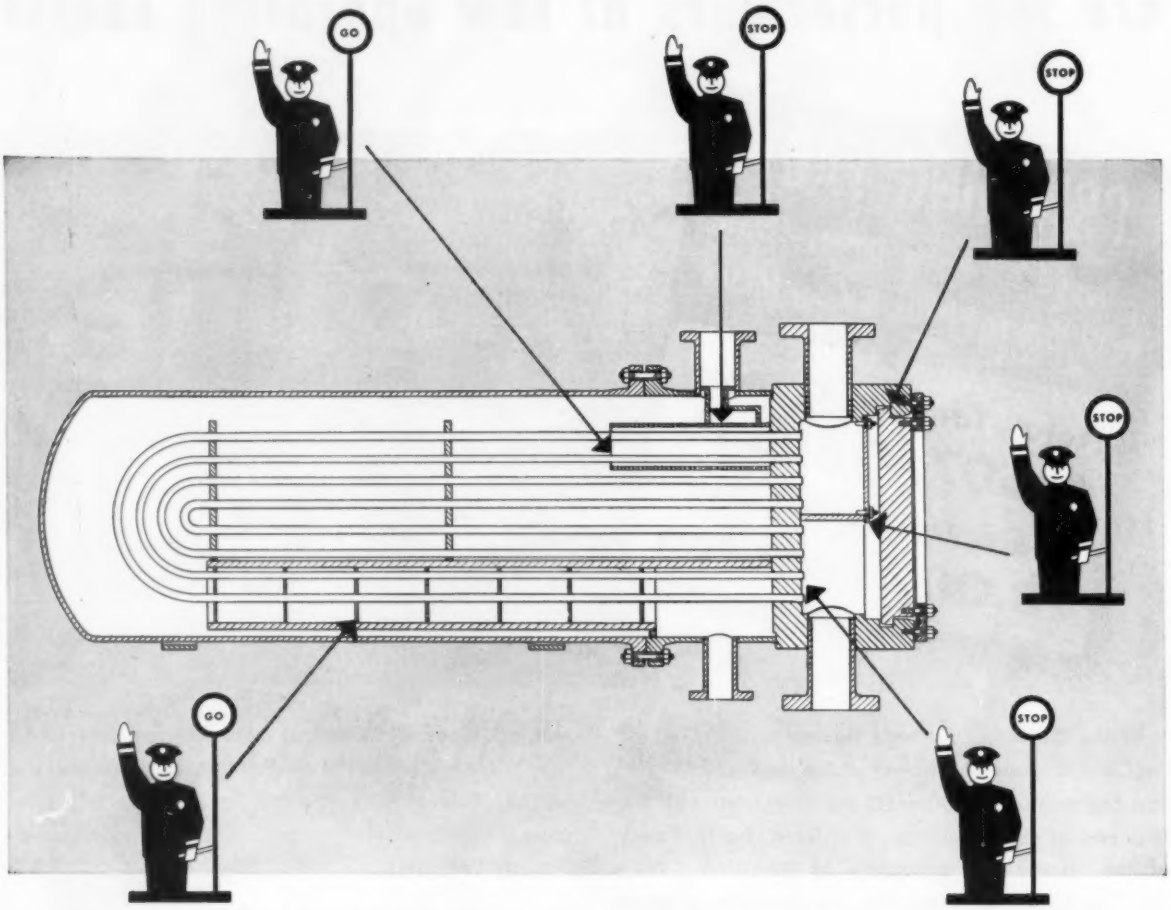


American
PULVERIZER COMPANY

*Originators and Manufacturers of Ring Crushers and Pulverizers*

1349 MACKLIND AVE. • SAINT LOUIS 10, MO.

# *The Feedwater Heater with Complete Traffic Control*




Traffic control in a feed water heater? Quite necessary, when you consider how inefficient the heating effect would otherwise be. Imagine the confusion of eddy currents and the consequent severe tube erosion if the steam entered without proper guidance.

In G-R Feedwater Heaters, control of both steam and water is complete and effective—the result of three quarters of a century's experience in the design of heat transfer apparatus by The Griscom-Russell Company.

Where the steam enters these G-R Heaters, its flow is first directed by an impact baffle; and when necessary, by a specially designed desuperheating enclosure before continuing its course through the heater. When sub-cooling is desired, the condensate is further guided through a sub-cooling zone before draining through the shell outlet.

Not only the steam in the shell, but also the water in the tubes is under constant control. Leak-tight tube joints and properly designed gasket joints throughout insure the safe routing of the water through the tubes.

Write for bulletin describing these control measures in detail. It also gives many other reasons why G-R Feedwater Heaters should be your choice, whether for low, medium or high-pressure service.

**THE GRISCOM-RUSSELL CO., MASSILLON, OHIO**

**G-R** HEAT TRANSFER APPARATUS **Feedwater Heaters**

GR 316

# TAKES THE BLOW OFF...
# CUSHIONS SHOCK

## PENFLEX TUBING

**ABSORBS THERMAL EXPANSION... PREVENTS BLOW-OUT**

WHEN SAFETY VALVES pop in this large industrial plant, a terrific surge of 900°F. steam blasts through the blow-off pipes under as much as 850 psi pressure. Ordinary pipe would blow apart. But Penflex Flexible Metallic Tubing has enough "give" to take the shock. Six lengths of 8" Penflex interlocked tubing cushion the sudden impact . . . take up any pipe movement due to extreme temperature and pressure changes.

The Penflex Engineer can help you solve your tough tubing problems. A complete line of Penflex Flexible Metallic Tubing, Hose, and Couplings is at your disposal—4-wall interlocked and seamless welded corrugated tubing and metallic hose from 1/8" to 24" I.D. . . . automatic barrel fillers, pneumatic rivet passers, and fittings. Write for the new illustrated data book, "Flexineering."

**Pennsylvania Flexible Metallic Tubing Company, Inc.**
**7237 Powers Lane, Phila. 42, Pa.**
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# PENFLEX

## HEART OF INDUSTRY'S LIFE LINES

# Why Put Up with Water Problems?

## MOGUL Solves Them *

## Surely and Economically

Are you putting up with expensive shut-downs and repairs that you take for granted are necessary to correct your water problems? If you are, Mogul can save you time and money.

Mogul makes mechanical cleaning unnecessary by preventing formation of hard deposits and scale and eliminating rust and corrosion. Foul up of cooling systems by algae and congestion is ended.

Because no *one* material can correct all water problems, Mogul selects a formula and applies it in amounts calculated from a water analysis of the particular job. Regular inspections by a Mogul man assure top efficiency and low cost.

Why waste time and money on periodic shut-downs for cleaning when Mogul can end them? Call in a Mogul Service Man to study your water problem. He's glad to survey the whole system and show you how Mogul eliminates water troubles. Fill and mail the coupon today. There's no obligation.

**MOGUL WATER TREATMENT PRODUCTS**

Mogul Rust Eradicator
Mogul Ever Clean Boiler Process
Mogul Anti-Foam • Mogul Amine • Mogul Algicide

**OTHER PRODUCTS**

Mogul Flue and Chimney Clean
Mogul Fuel Oil Treatment
Horneblende Compound

The North American
MOGUL
Products Company
Cleveland 13, Ohio

**The North American Mogul Products Company, Cleveland 13, Ohio**

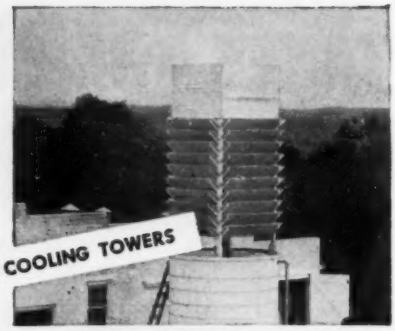
Have the Mogul Man call on

MR._____

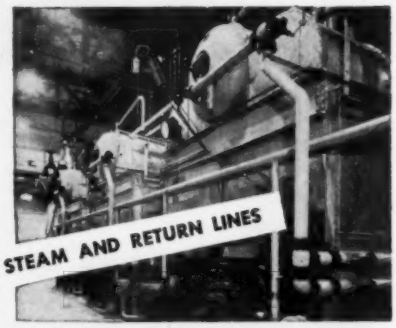
TITLE_____

COMPANY_____

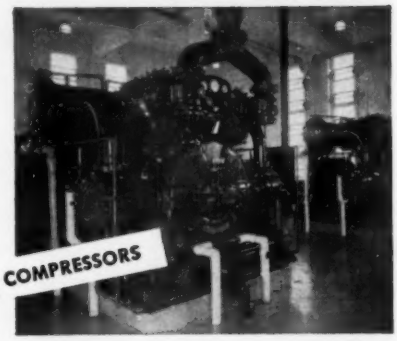
ADDRESS_____



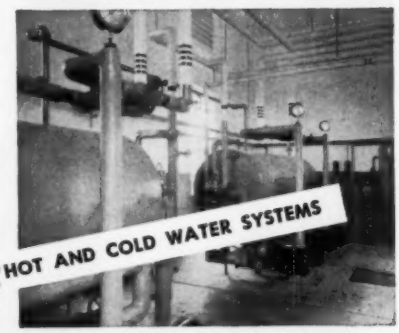
* COOLING TOWERS



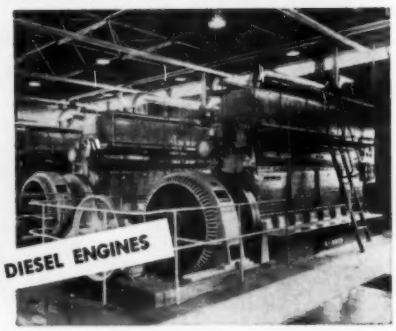
* STEAM AND RETURN LINES



* COMPRESSORS



* HOT AND COLD WATER SYSTEMS



* DIESEL ENGINES

CHASE

**... PIN-POINTING TROUBLE BEFORE IT STARTS!**

By expanding Antimonial Admiralty Condenser Tubes over a tapered pin in the laboratory, Chase metallurgists check the ability of the tube to withstand expanding and flaring operations during installation.

## Another reason why

# Chase®

## *Antimonial Admiralty Condenser Tubes last longer!*

For Condenser Tubes that stay on the job year in, year out, insist on Chase Antimonial Admiralty.

What's the secret? *Enough* antimony to resist dezincification effectively. Does antimony adversely affect the strength or other properties of admiralty? Definitely not! The antimony imparts corrosion resistance which assures long life under many different water conditions.

So, whether you're replacing condenser tubes, or planning a new installation, specify Chase Antimonial Admiralty!

**PROMPT SHIPMENTS from our mills in Cleveland and Waterbury.**

Chase® BRASS & COPPER

WATERBURY 20, CONNECTICUT • SUBSIDIARY OF KENNECOTT COPPER CORPORATION

*The Nation's Headquarters for Brass & Copper*

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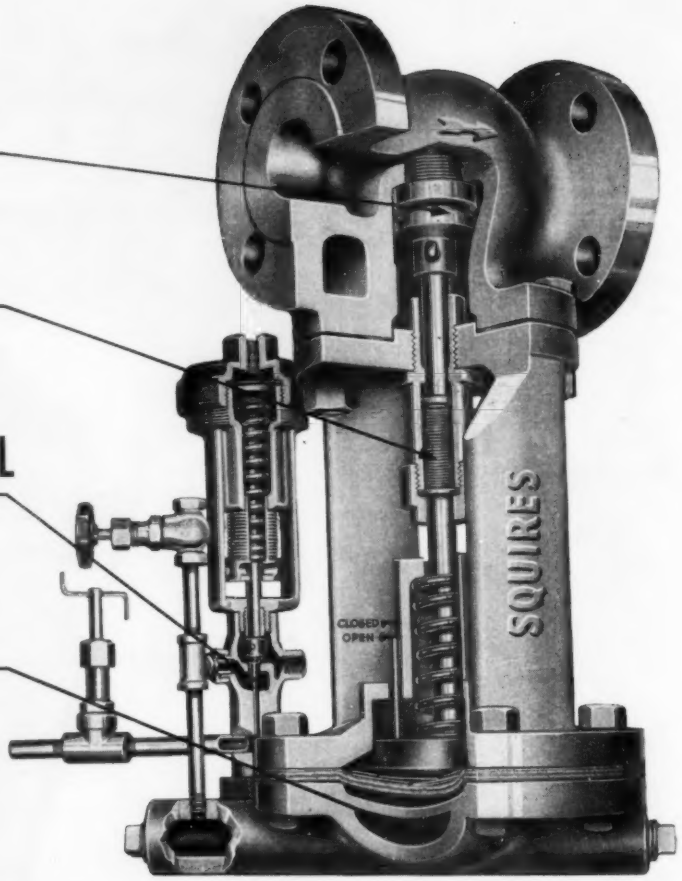
SINGLE SEATED

PACKLESS CONSTRUCTION

PRECISION PRESSURE CONTROL

POSITIVE DEAD-END VALVE

**ACCURATE TO OUNCES**




# ONE-STEP PRESSURE REDUCTION

**Single Seat and Disc** construction gives accurate flow control to maintain a constant desired reduced pressure. The valve design together with the Squires Patented Diaphragm also gives full opening allowing maximum capacity.

**Packless Construction** available through 3" sizes, gives frictionless movement for accurate low pressure control. In addition, maintenance is minimized for trouble-free service.

**Precision Pressure Control** is constantly maintained through the Patented Squires Pilot—the heart of the reducing valve. Being an outside pilot it allows for ease of adjustment and accessibility to working parts. Pressure reduction can be made from 600 p.s.i. to ounces in one step.

**Positive Dead-End Control** is guaranteed by the closing force resulting from the magnifiication of the high pressure on the main diaphragm—giving positive shut off when maximum low pressure is reached. For example on a 1½" valve with 100 p.s.i. initial pressure the dead-end force on the seat is 3,000 pounds—a ton and a half.

**Standardize on Squires Valves**—initial investment is low—operation is efficient and trouble-free—maintenance costs are minimized through interchangeability of parts. Get all the facts for yourself about **SQUIRES REDUCING VALVES.**

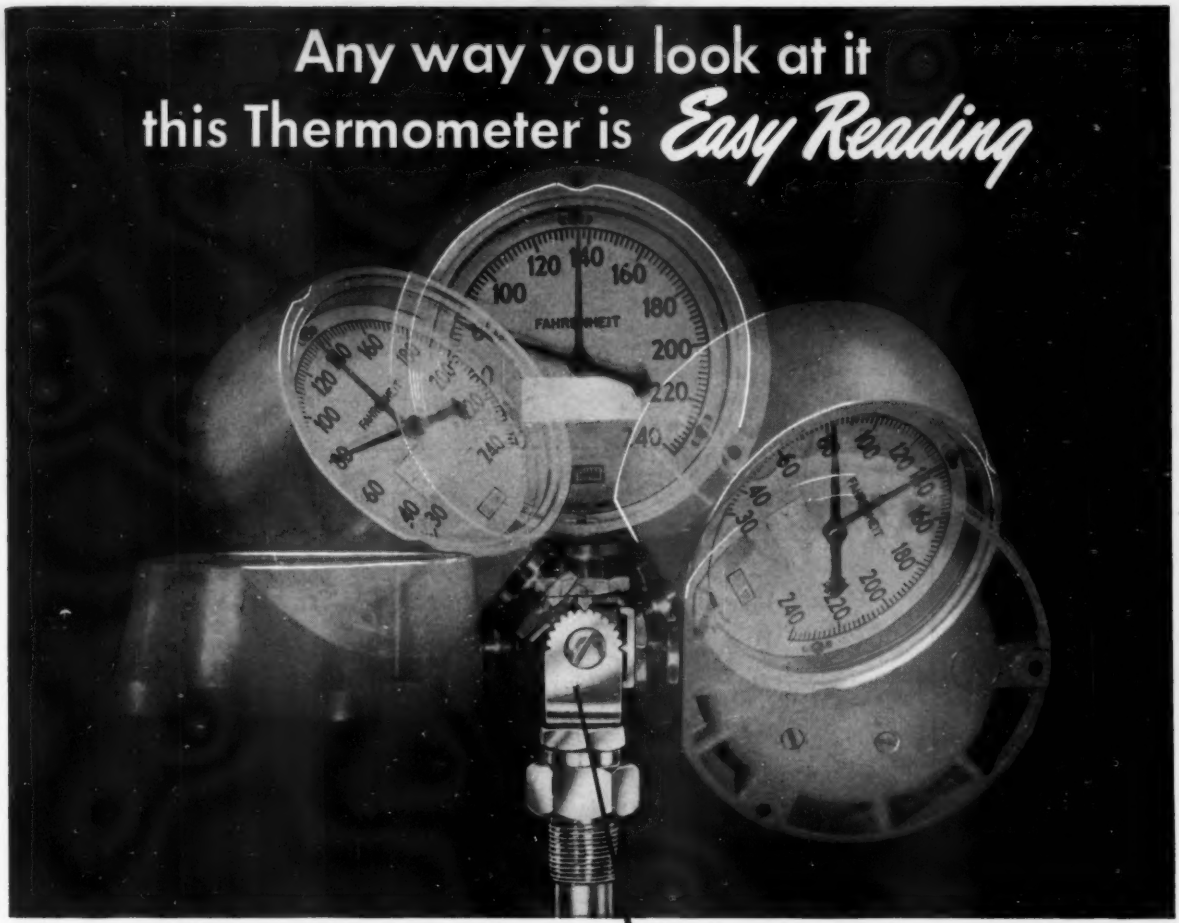
***Write today for complete Bulletin #53-A***

**THE C. E. SQUIRES COMPANY**

*Over 50 Years of Dependability*

18502 SYRACUSE AVENUE • CLEVELAND 10, OHIO

# Any way you look at it this Thermometer is *Easy Reading*



You've been asking for a dial thermometer like this—A thermometer that can be positioned and firmly locked at any practical angle—now you can have it!

No stretching or straining to see this thermometer. Easy to adjust to required new positions before or after installation. No risk of the multi-angle selector working loose. A specially designed selector assures positive locking at every practical mounting angle and a few turns of *one* nut lock the selector securely.

These instruments, supplementing USG's complete line of Gotham temperature indicators, are designed to fit all standard connections and are available in all standard ranges. If you have a number of applications requiring "odd angle" mounting these new multi-angle thermometers will reduce the number and variety of instruments you have to carry in stock.

Before you order an angle thermometer be sure you see USG's new Gotham Multi-Angle Thermometer.

UNITED STATES GAUGE

## ADVANTAGES

1. Positive locking in every conceivable angle.
2. Reduces the number and variety of instruments required in your maintenance stock.
3. Provides that extra "odd angle" instrument which normal stock does not furnish.
4. Easy to change to any desired angle, before or after installation.
5. Saves engineers time when writing specifications.
6. Affords easy reading at odd angles.

Dept. 4
United States Gauge
Division of American Machine and Metals, Inc.
Sellersville 4, Pa.

Gentlemen:
We'd like to know more about the new USG Multi-angle Thermometer. Please get in touch with us.

Name_____ Title_____

Company_____

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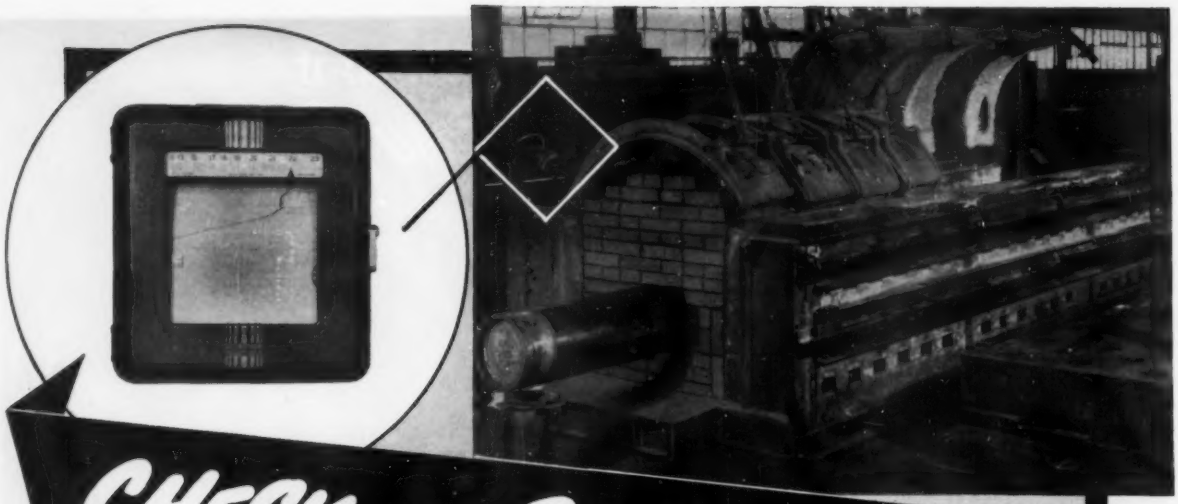
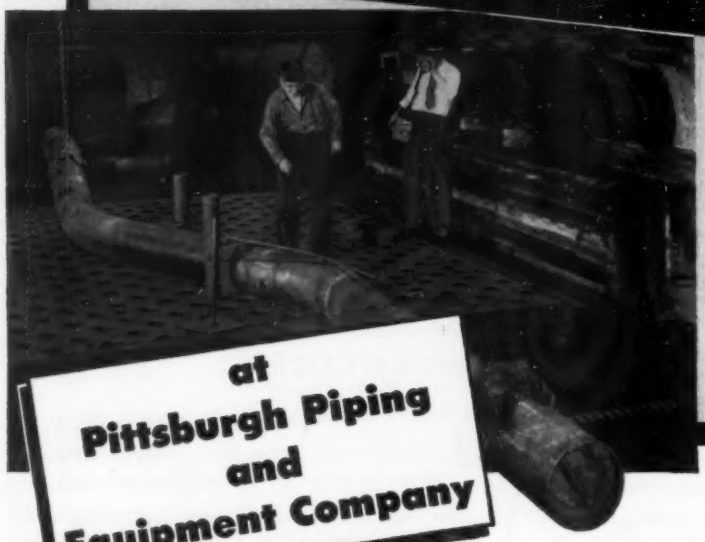
City_____ Zone_____ State_____



# CHECK and DOUBLE CHECK



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The temperature to which P.P.&E. piping is subjected before bending is measured by a Ray-o-Tube which projects through the furnace wall . . . and recorded on the chart of the Micromax instrument.

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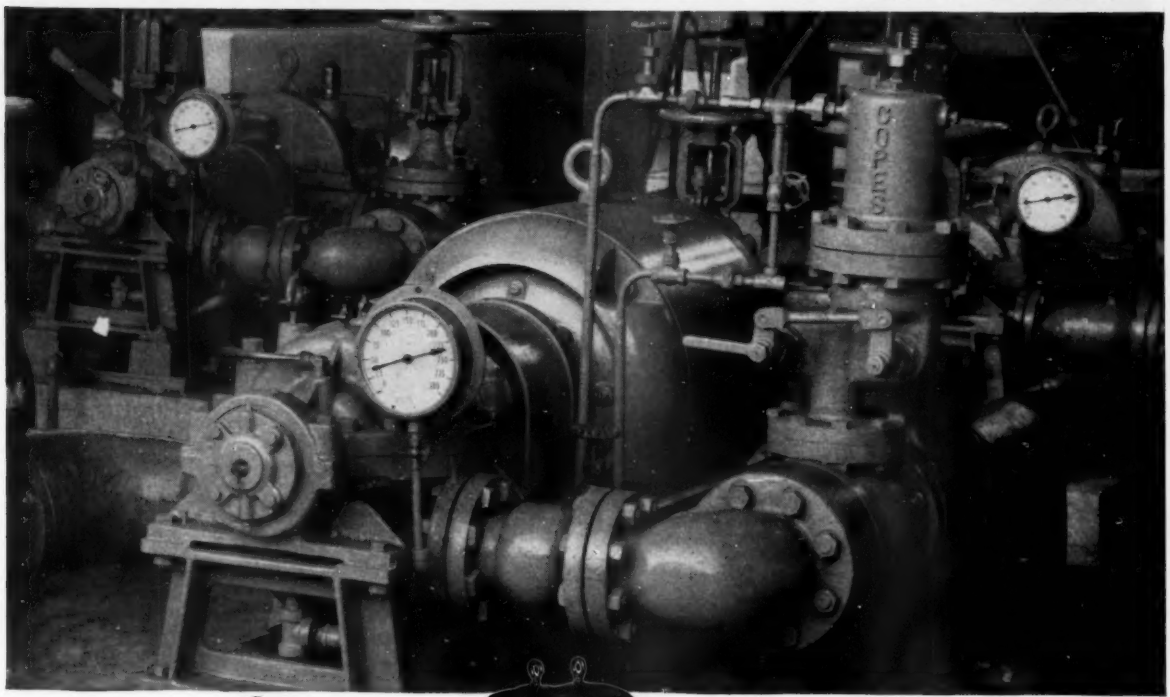
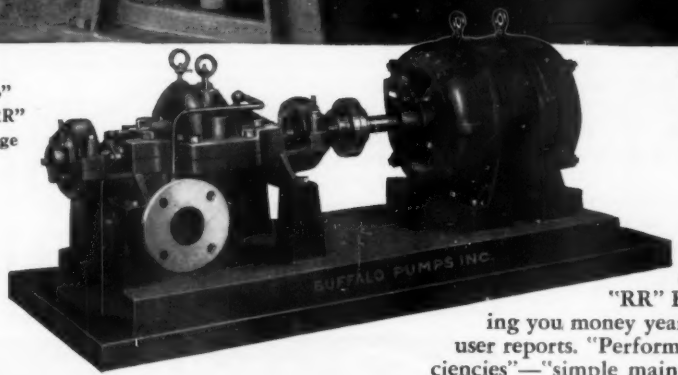
PP-1

# Cut POWER COSTS

## AT THIS IMPORTANT POINT

## — IN BOILER FEED PUMPING



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Not only moderate in first cost, but a real dollar-saver in maintenance, the rugged "RR" Boiler Feed Pump will keep right on saving you money year after year. We know this by the actual user reports. "Performance as rated"—"exceptionally high efficiencies"—"simple maintenance"—"long life" headline these reports. 2- and 4-stage models to handle your requirements. For heads clear up to 1500 ft. Engineering Bulletin 980-C shows how you can cut *your* power costs in the boiler feed department, with "Buffalo" Type "RR" Pumps! Write for your copy.

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# SEND FOR THIS 32 PAGE MULTICLONE BOOKLET

**HELPFUL-INFORMATIVE IT OUTLINES THEORIES AND BASIC PRINCIPLES OF CENTRIFUGAL DUST RECOVERY!**

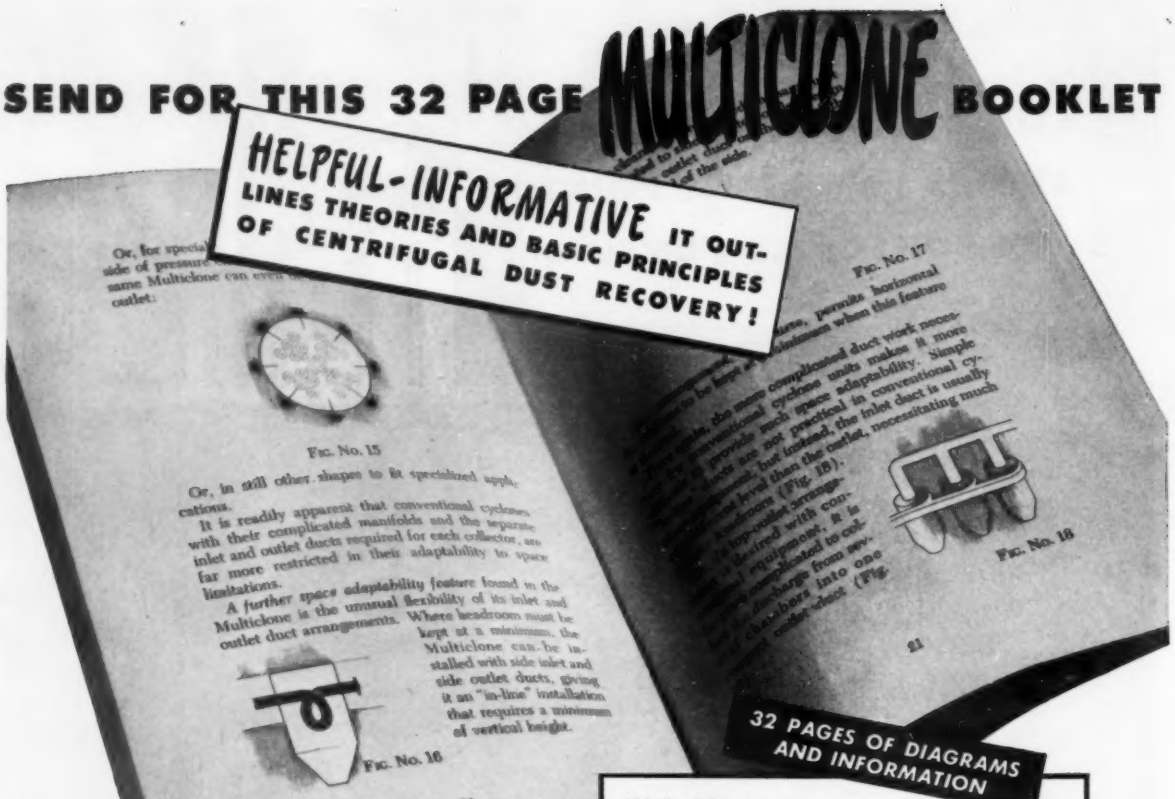
Fig. No. 15
Or, in all other shapes to fit specialized applications.
It is readily apparent that conventional cyclones with their complicated manifolds and the separate inlet and outlet ducts required for each collector, are far more restricted in their adaptability to space limitations.
A further space adaptability feature found in the Multiclone is the unusual flexibility of its inlet and outlet duct arrangements. Where headroom must be kept at a minimum, the Multiclone can be installed with side inlet and side outlet ducts, giving it an "in-line" installation that requires a minimum of vertical height.
Fig. No. 16
20
Fig. No. 17
Fig. No. 18
21
32 PAGES OF DIAGRAMS AND INFORMATION

NO MATTER whether you are now using mechanical dust recovery equipment or are planning the installation of such equipment at some future date, here is a booklet that is full of helpful and valuable information on centrifugal dust recovery. It not only explains the basic methods and principles involved, but also shows the important differences between small and large diameter separating tubes, shows how to simplify your duct work and reduce installation costs, and outlines many other important factors to be considered in selecting mechanical dust recovery equipment.

In addition, this informative booklet illustrates and explains how MULTICLONE'S unique *vane* design is fundamentally different...how it makes possible greater compactness, simpler installation, high recovery of the small particles as well as the medium and coarser ones, and many other facts on MULTICLONE advanced design.

A limited supply of these booklets is available for free distribution to those interested in mechanical recovery equipment and methods. Write for your copy today.

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**MULTICLONE'S SPACE SAVINGS**...How the Multiclone requires less square footage, less cubic footage than most other equipment of comparable capacity and performance, thus saving costly plant space!

**MULTICLONE'S ADAPTABILITY**...How the Multiclone is more adaptable to varying inlet-outlet requirements—to varying space limitations—and is simpler to insulate, thus reducing installation costs!

**MULTICLONE'S EFFICIENCY**...How Multiclone's multiple *small diameter* tubes, made possible by its exclusive vane design, give higher centrifugal forces and more complete cleansing of *all* suspended particles—even small ones of 10 microns and less!

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# NORDBERG *SUPAIRTHERMAL** DUAFUEL® ENGINE

## HIGH EFFICIENCY INCREASES POWER PLANT PROFITS

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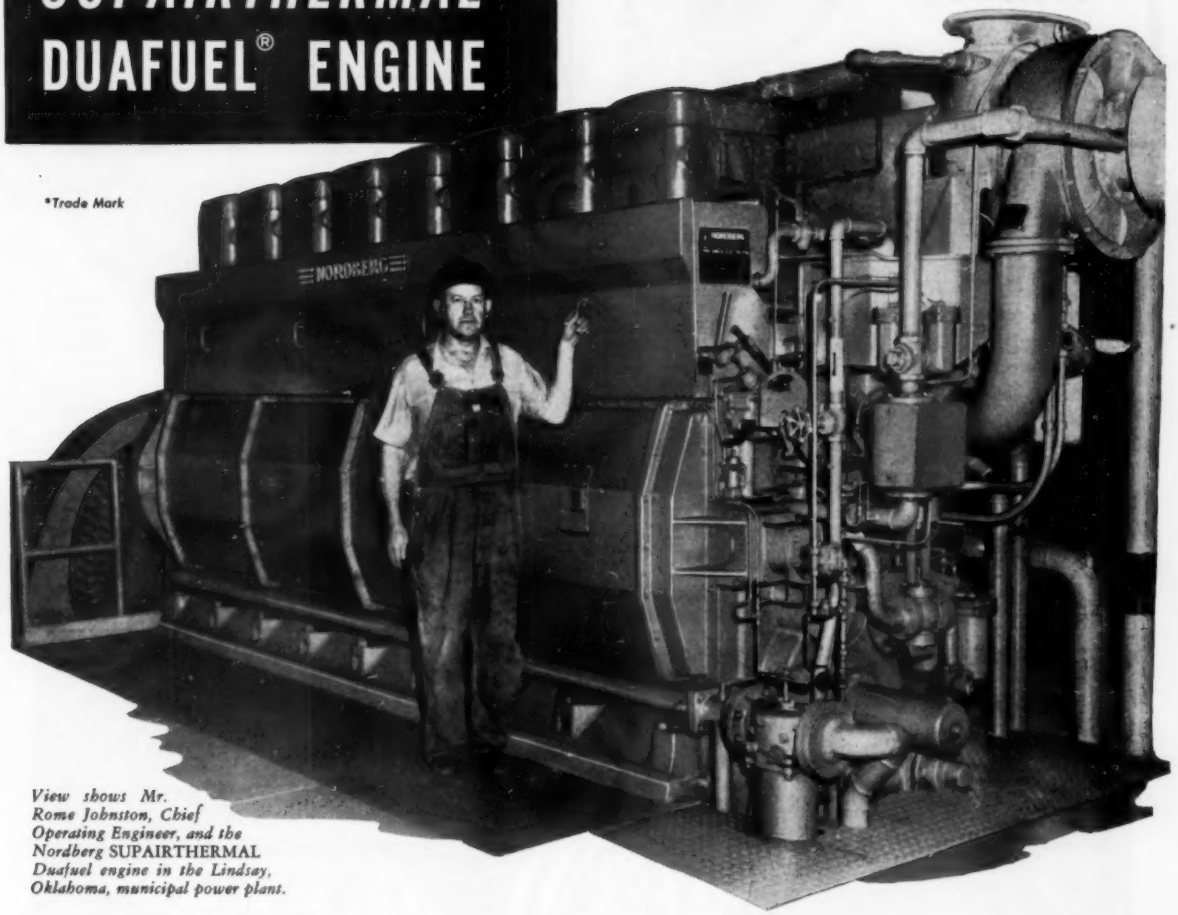


*View shows Mr. Rome Johnston, Chief Operating Engineer, and the Nordberg* SUPAIRTHERMAL *Duafuel engine in the Lindsay, Oklahoma, municipal power plant.*

AT the Lindsay, Oklahoma, municipal plant, a Nordberg *SUPAIRTHERMAL* Duafuel engine is generating energy at an average fuel cost of 2.5 mills per kwh at 58.5 percent average load factor. This Nordberg four-cycle, 8-cylinder engine is rated 1425 horsepower, 1000 kilowatts, at 450 rpm.

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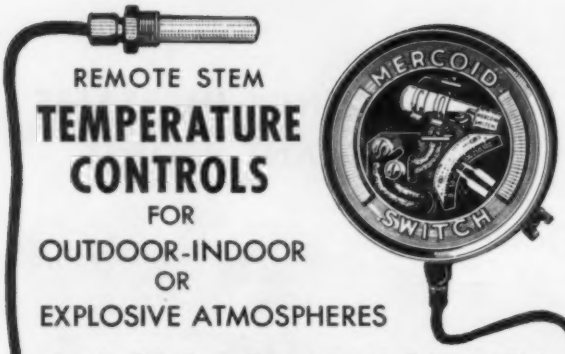


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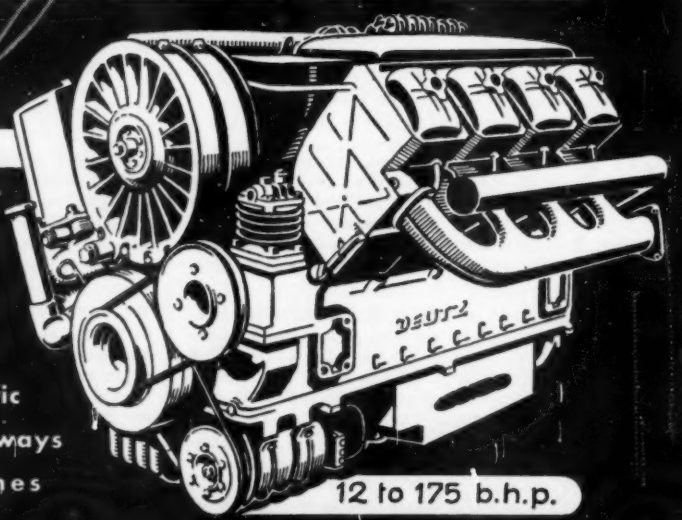


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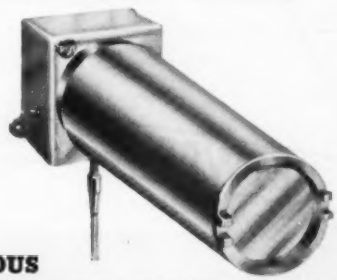

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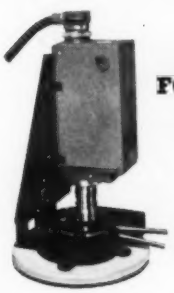

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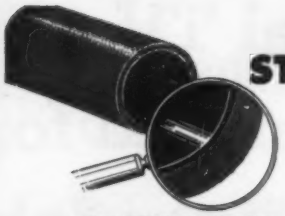

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*"Corrosion can be prevented by using materials that are not attacked by sulfuric acid. Special glass appears to offer good possibilities . . . "

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*Reprinted from Bureau of Mines Report of Investigations 4996

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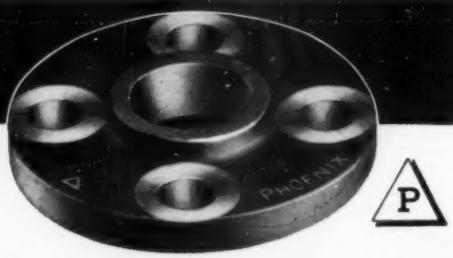


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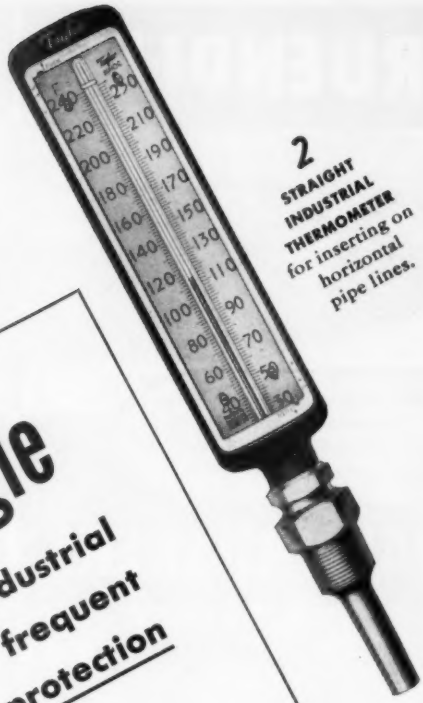

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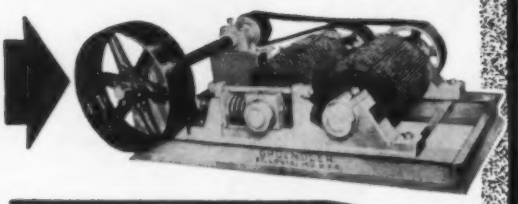
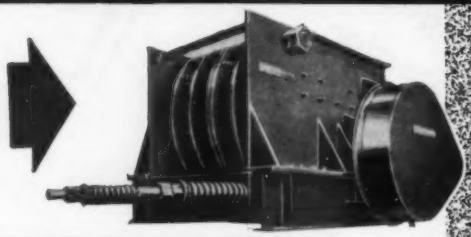


Double Roll Crusher (hopper and cover removed to show cone type teeth). For domestic secondary crushing in the 1" to ⅜" range. Produces minimum fines and dust.

## COAL CRUSHERS



Single Roll Crusher. Heavy duty, roller bearing constructions. For ROM and strip mine coal and as preparation for further reduction and gradation.

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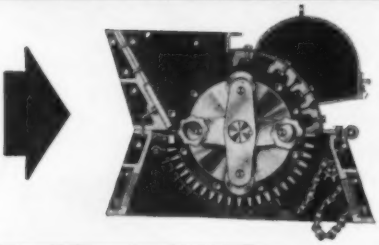

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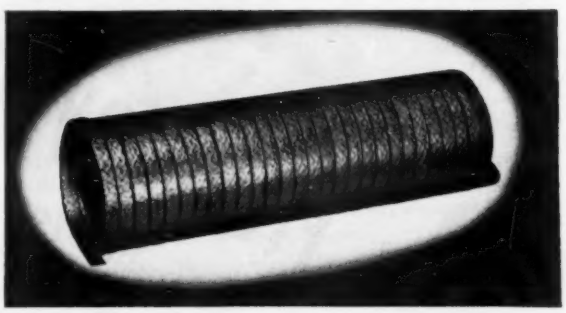

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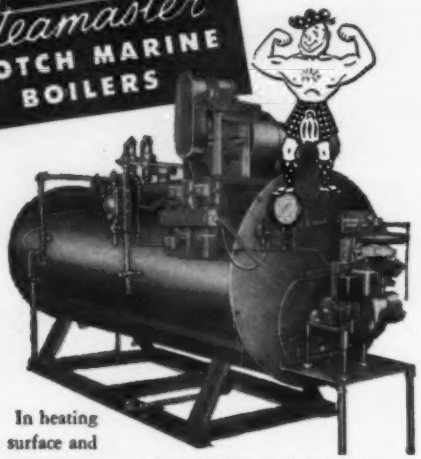

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5819 Compton Ave., Los Angeles 11, California • LUcas 6226

**Power's**

**"NEW POWER CONSTRUCTION"**

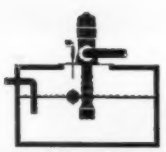
is a monthly bulletin listing major building projects in the power field: new power plants, industrial buildings, commercial and public buildings, waterworks and sewage plants. Gives addresses, contractors, cost estimates.

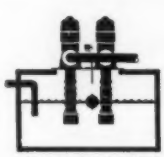
A valuable check list for manufacturers and salesmen. Only one dollar per year. For full information and sample copy, write POWER, 330 West 42 St., New York 36, N. Y.

**For Longer Life—Trouble Free Service And Higher Sustained Efficiency**

**IT'S NEW**

*Send for your free copy of our new bulletin—*


SINGLE UNIT INSTALLATION

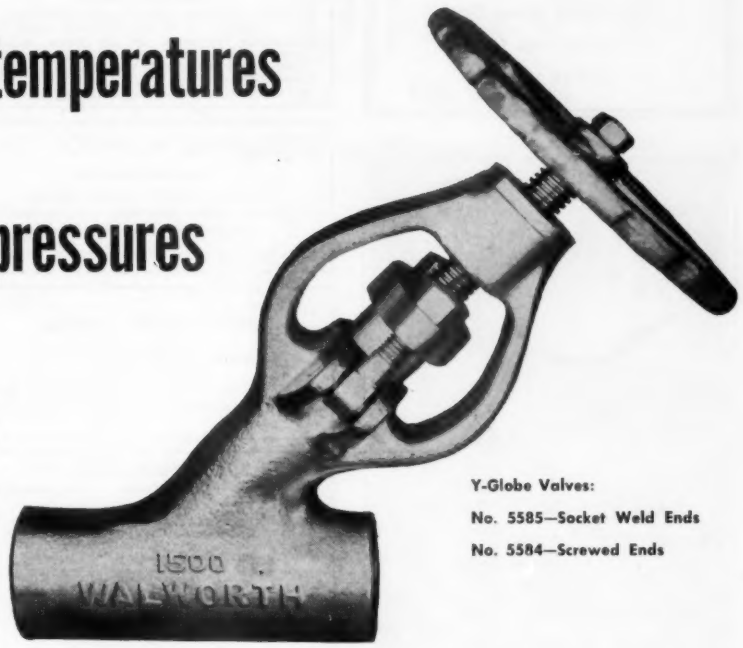

DUPLEX APPLICATION

**JOHNSTON PUMP COMPANY,** *Bin "K," Pasadena 19, California*

# Walworth's NEW small cast steel valves

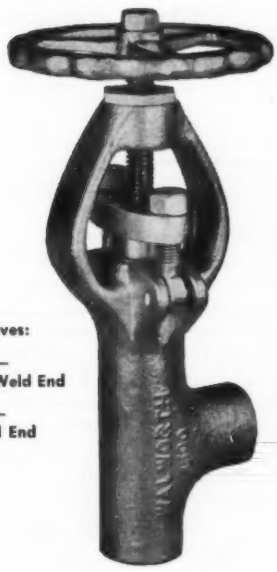
## SERIES 1500 – SIZES ¼ to 2 inches

handle { HIGH temperatures / HIGH pressures




Y-Globe Valves:
No. 5585—Socket Weld Ends
No. 5584—Screwed Ends

Walworth is proud to make these new Small Cast Steel Valves available to power stations . . . oil refineries . . . ships . . . wherever piping is subject to severe pressures and temperatures. Non-shock service ratings of these valves: 1500 psi–950F for steam; 3600 psi–100F for water, oil or gas. Cast of chromium molybdenum steel, they are compact and light, yet exceptionally strong. Both Y-Globe and Angle type valves are available.



Angle Valves:
No. 5587—
Socket Weld End
No. 5586—
Screwed End

Simplified Walworth design eliminates many of the valve problems encountered in high pressure service. Among the features of this new valve are:

**INTEGRAL BODY AND YOKE** – made from a single casting without threading or welding. Bonnet joint — always a potential source of leakage — is eliminated. Valves can be reassembled quickly and easily.

**ROTATING DISC** – prevents valve seat distortion and consequent leakage. Cuts down replacements.

**WELDED SEAT RING** – compensates for changes in pressure and temperature—eliminates a major source of leakage.

**SPECIAL BACK SEAT BUSHING** – permits repacking the valve under pressure with greater safety.

**PACKING CHAMBER** – designed to dissipate heat thus keeping packing rings at lower temperatures—gives them longer life.

These valves are available with either socket weld ends or screwed ends, in sizes ranging from ¼ to 2 inches. For further information on Walworth series 1500 Small Cast Steel Valves, see your local Walworth distributor, or write for Circular No. 134.

# WALWORTH

**valves • fittings • pipe wrenches**

**60 EAST 42nd STREET, NEW YORK 17, N. Y.**

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

# WHERE TO BUY

*Featuring additional products, specialties & services for power plants*

**GAGE GLASSES AND**
**High Pressure Rubber Gaskets**
**ALL SIZES TO FIT YOUR GAGES**

ERNST WATER COLUMN & GAGE CO.
Send for Catalog LIVINGSTON, N. J.

**STOP that WATER**

With FORMULA NO. 640, a clear liquid which penetrates 1" plus in concrete, brick, stucco, plaster, etc. Seals out water, dirt. Holds 20' head. Use outside and in. Preserves all absorbent materials. Sold 14 years. Quick, economical, sure. $3 in 55's. Free sample. See Sweet's.
HAYNES PRODUCTS CO., OMAHA 3, NEBR.

**TO manufacturers of equipment and those offering special services to the power industry, this section offers an inexpensive means of keeping products or services regularly before your potential customers — the readers of POWER. The small spaces available here provide opportunity for you to be represented in every issue at low cost. Can we serve you?**

**Classified Advertising**
**POWER**

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*Thermo Engineers*
HIGH TEMPERATURE WATER SYSTEMS FOR DISTRICT AND INDUSTRIAL HEATING
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Power Plants Consultations
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PUMPING PLANTS—ELECTRIC SYSTEMS
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*Specializing Since 1927*
Water Treatment for corrosion control in buildings, boilers and air conditioning systems.
New York—Philadelphia—Washington, D. C.

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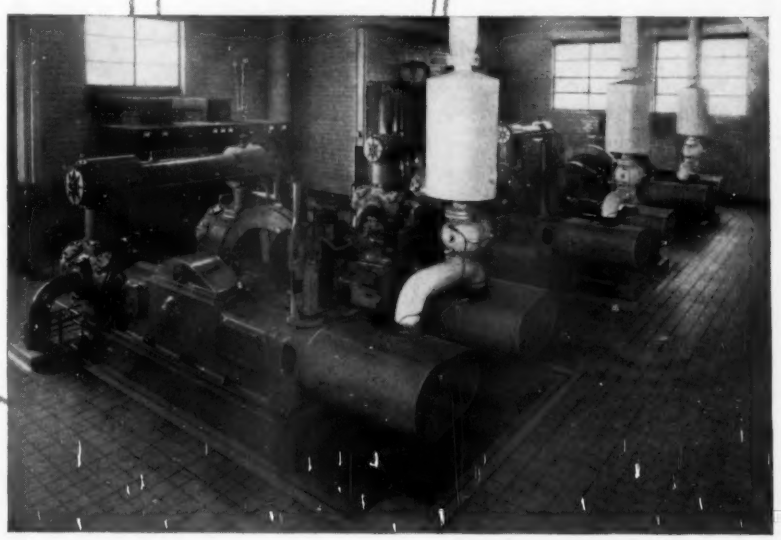
Design-Construction-Reports-Appraisals
80 Broad Street, New York 4

# Putting STEAM to Work with a Class H Compressor

Chicago Pneumatic's horizontal duplex, Class H steam-driven compressor brings real operating economies to plants where low cost steam or exhaust steam is available. Economical steam end proportioned to plants' steam conditions, automatic cut-off governor, and Simplate valves are just a few of the many outstanding features that add to the machine's long, dependable life and high overall efficiency.

Capacities range from 900 to 7400 cfm. (100-125 lb. air, 200 to 1250 hp). Other types and sizes available for lower and higher pressures.

*Chicago Pneumatic Tool Company, 8 East 44th Street, New York 17, New York.*



Chicago Pneumatic

PNEUMATIC TOOLS • AIR COMPRESSORS • ELECTRIC TOOLS • DIESEL ENGINES • ROCK DRILLS • HYDRAULIC TOOLS • VACUUM PUMPS • AVIATION ACCESSORIES

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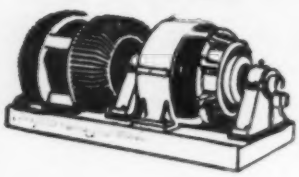
*NEW ADVERTISEMENTS, N. Y. Office, 330 W. 42nd St., N. Y., for the March issue closing February 9th*

## SEARCHLIGHT EQUIPMENT SPOTTING SERVICE



This service is aimed at helping you, the reader of POWER, locate used and surplus new power equipment not currently advertised (this service is for user-buyers only).

First, read the dealer ads on the following pages. A 5-minute study may locate the equipment *now*.

Second, send in the specifications of the equipment wanted on the coupon below, or on your own company letterhead, to

**Searchlight Equipment Spotting Service**
**c/o POWER**
**330 W. 42nd St., N.Y. 36, N.Y.**

Your requirements will be brought promptly to the attention of the used equipment dealers advertising in this issue. You will receive replies directly from them.

**NO CHARGE • NO OBLIGATION**

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**Searchlight Equipment Spotting Service**
**c/o POWER**
**330 W. 42nd St., New York 36, N. Y.**

Please help us locate the following used equipment:

.....

.....

.....

.....

NAME ..... TITLE .....

COMPANY .....

STREET .....

CITY ..... ZONE ..... STATE .....

2/54

## WANTED

### 'Hungry' Manufacturer's Representatives

We are an established concern that designs and builds large industrial installations for air pollution control sold in the United States and Canada. We are willing to revamp our representation in any area to meet the competitive selling era ahead. Earning potentiality is high for the alert representative organization. If interested please write full particulars as to: territory covered, types of equipment presently handled, industrial fields contacted, and indications of success on other products of this type. Replies held in strictest confidence. Write care of this publication, RW-1263, 330 W. 42 St., New York 36.

*Address to office nearest you*
*REPLIES (Box No.):*
*NEW YORK: 330 W. 42 St. (36)*
*CHICAGO: 520 N. Michigan Ave. (11)*
*SAN FRANCISCO: 68 Post St. (4)*

### SELLING OPPORTUNITY OFFERED

SALES ENGINEERS, with a knowledge of steam boiler operation and maintenance and experience in selling to the industrial heating and power plant trade, are wanted for permanent service in choice territories in various states. Assignment involves the sale of a combustion type a triple action fuel oil conditioner, to commercial and industrial plants. High income arrangement on initial and repeat orders assures good substantial year 'round earnings. Address applications to KOR Division, Dept. GW, P.O. Box 485, Gary, Indiana.

### EMPLOYMENT SERVICE

SALARIED PERSONNEL, $3,000-$25,000. This confidential service established 1927 is geared to needs of high grade men who seek a change of connection under conditions assuring, if employed, full protection to present position. Send name and address only for details. Personal consultation invited. Jira Thayer Jennings, Dept. G, 241 Orange St., New Haven, Conn.

### POSITIONS WANTED

OVERSEEING CONSTRUCTION, and/or, operation, and maintenance, moderate size plant. Age 49, 29 years experience. Agricultural district preferred. Now assistant superintendent twenty thousand kilowatt plant. Will consider operating job leading to supervision. Not a college graduate. PW-1099, Power.

*(Continued on the opposite page)*

## Mechanical Engineers

**Power Plant**

Large engineering and construction firm offers staff positions to qualified Mechanical Engineers. These positions are permanent and generous company benefits are included. Salary is commensurate with experience and education. Work involves plant betterment and supervising starting, testing, operating and correcting troubles of Steam Electric Station equipment. Considerable travel is required. A technical education is preferred and power plant operating or betterment experience necessary.

**PLEASE GIVE COMPLETE DETAILS OF BACKGROUND, INCLUDING: EDUCATION, EXPERIENCE, PERSONAL DATA AND SALARY DESIRED.**

*All replies will be promptly acknowledged.*

**P-1377, POWER**

**330 W. 42nd St., New York 36, N. Y.**

## POSITIONS WANTED

*(Continued from opposite page)*

PLANT ENGINEER. Age 56: 40 years of practical experience on laying out, erecting, operating and repair steam engines and boilers, electric motors and generating equipments of all kinds, refrigerating and air conditioning plants of all sizes. Good leader of men and can get results. Desires a position as a plant Engineer or general Superintendent. PW-1378, Power.

CENTRIFUGAL PUMP Engrg. or Design chief, over 35 yrs. experience producing nearly all sizes and types. Excellent references. PW-1219, Power.

CENTRAL THERMAL stations constructor, electrical engineer, BSEE 1938, EE 1944, 37, single, registered, 15 years' experience particularly on large (20,000 KW-up) steam-electric central stations electrical construction supervision in U.S.A., exept two years in Asia. Energetic coordinator—administrator. Some power utilities management, some practical civil at central stations. Wide civilian travel in North America, Europe, Asia; wide military travel in U.S.A. Available world wide. PW-1136, Power.

MECHANICAL ENGINEER 20 years practical experience maintenance and operation of turbines, diesels and reciprocating engines, high and low-pressure water- and fire-tube boilers. dc and ac electrical systems, refrigeration plants. Supervision of crew and planning work layouts, safety condition. Passed U.S. Coast Guard fire and safety examination. Born 1909, Sweden, educated there, U.S. citizen. Desires position supervising plant operation, maintenance safety with large industrial company. PW-1395, Power.

EXPERIENCED SWITCHBOARD Operator would like operating job in central or substation. PW-9867, Power.

## FOR SALE

**MODERN 1000 KW Turbo-Generator**

***in excellent Condition***

Non-Condensing, Steel case 80# back pressure .8 P.F., 3 phase, 60 cycle, 4150/2300 volts, alternating current, complete with accessories, switchboard, oil circuit breaker and direct connected exciter. Only operated alternately for six years. Ideal for Chemical, Rubber, Petroleum. Textile, Pulp and Paper, and Sugar Refining Industries.

**NEWMAN & COMPANY, INC.**

6101 Tacony St. Philadelphia 24, Pa.

## ELECTRICAL FUSES

**Any Amperage • Any Voltage**

We carry on hand the largest surplus stock of electrical fuses in the world. Over 50,000,000 in stock. We guarantee a minimum savings of at least 20%. We invite your inquiries. Specials are our specialty.

**Electrical Products Sales Corp.**

P.O. Box 546 Hoboken, N. J.

**WE BUY SURPLUS FUSES**

## ELECTRICAL INSPECTORS WANTED

By the Tennessee Valley Authority for inspection of major electrical equipment and materials at manufacturing plants located in cities such as Philadelphia, Pittsburgh, Schenectady, and Milwaukee.

Work includes inspection of material and equipment during all stages of manufacture, witnessing factory tests, conferring with shop officials, and preparing necessary inspection and test reports. Some of the materials and equipment involved are generators, transformers, oil-circuit breakers, communication equipment, switches, insulators, and wire.

Persons with factory experience on inspection of electrical equipment and materials used in construction of hydro and steam electric generating plants are desired.

Entrance salaries are $4575 and $5450 a year for 40 hour week. Vacation, sick leave, and retirement benefits. *Write to the*

**TENNESSEE VALLEY AUTHORITY**

Division of Personnel, Knoxville, Tennessee

## WANTED

**WE BUY NEW & USED ELECTRICAL SURPLUS**

**Wire & Cable • Conduit Fittings**
**Wiring Devices • Switches**
**Electronic Components • Fuses**
**Motors • Transformers, Etc.**

*Phone—Rochester GLenwood 8840*

**DIAMOND ELECTRIC CO.**

P. O. BOX 1632 • ROCHESTER 3, N. Y.

## CONDENSER

1—used Westinghouse Powerhouse Surface Condenser, three pass, 843 square feet, with hot well. No pumps.

## PUMPS

1—used McGowan Steam Pump, duplex, 5¼ x 3½ x 5, with bedplate and mechanical lubricator.

1—used National Steam Pump, duplex, 6x4x6. No bedplate or lubricator.

**BURFORD, HALL & SMITH**

**140 EDGEWOOD AVE., N.E.**

**ATLANTA 3, GA.**

Diesel-elec. generator sets, 1000 KW, G.M. (3), 700 KW Nordberg, 250 v. d.c. F-Morse 392 KW a.c.
Locomotive, crawler and Whirley cranes.
Euclid 25-ton bottom dump coal haulers (5).
Rotary dryers, 5', 7' and 8' dia.
Locomotives, diesel, gas, 7 to 60 tons.
Power shovels, draglines, ⅛ to 12 yds.
Marine engines (5). Cat DW10 wagons (3).

**H. Y. SMITH CO.**

828 N. Broadway Milwaukee 2, Wis.

**$ CASH MONEY $**

**WE BUY ELECTRIC SUPPLIES • MOTORS • TRANSFORMERS • WIRE • CABLE**

SEND LISTINGS

**ALLIED ELECTRIC COMPANY**

Box 1838—1122 Falls Bldg., Memphis, Tennessee

## IMMEDIATE DELIVERY

For Portable or Stationary Service Self-contained

General Motors Diesel Engine driven Generators. 75 KW 3/60/2200/440 $4800.00. Three 1000 KW 3/60/2400/4160 $110,000.

*Please send your requirements.*

**GLEN MOORE DIESEL MFG. CO.**

Glenmoore, Pa. Telephone Eagle 8-8115

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***(Yes, get better stationary engineers License!)***

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 524 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

## GENERATOR WANTED

4000-5000 Kw, 3600 RPM generator preferably 2400 V; also De-aerating feed water heater; 7.5 KV Circuit Breakers 100 MKVA Interrupting capacity.

**Utility Equipment & Construction Co.**

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## 3 A. C. GENERATORS

Skinner Engine 250 KVA—200 K.W.—208/120 Volts 693 Amps.—3 PH. 60 CYC.—25% o.l. For 2 Hrs. All In Perfect Condition.

**FS-1189, POWER**

**330 W. 42nd St., New York 36, N. Y.**

## WANTED

**STEAM TURBINE GENERATOR SET**

For use in Canada, 3500 to 5000 KW. 3/60/4800 volts, 400 PSI, 15 PSI discharge pressure.

**SOUL CLINIC, INC.**

CALGARY, ALBERTA, CANADA

## B & W BOILERS

We own and offer for immediate sale a number of good used 250 H.P. sectional steel header 200# W.P. Babcock & Wilcox boilers with or without chain grate stokers and auxiliary equipment. Call, wire or write

**SUMMER & CO.**

3937 Main St., Kansas City, Mo. JEfferson 6400

# There's more than 40% to 60% SAVINGS on

## SCHOONMAKER DEPENDABLE DIESEL POWER

## because:

Each Schoonmaker-sold Diesel Engine Unit is fully REMANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

The Schoonmaker Plants and Warehouses located in Jersey City, N. J. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

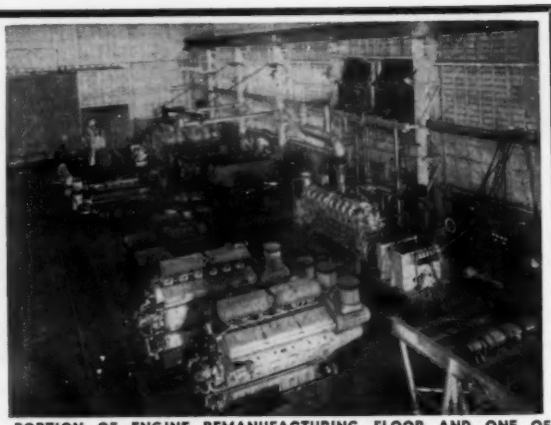
*America's largest source of New and Remanufactured Diesel Power*

A.G.

## SCHOONMAKER CO., INC.

**50 CHURCH ST., NEW YORK 7, N. Y.**

PLANTS AND WAREHOUSES:
JERSEY CITY, N. J. AND SAUSALITO (S.F.), CALIFORNIA
TELEPHONE — DIGBY 9-4350 • TELETYPE — NY 1-2804
W. U. WIRE • CABLE — AGSCOMACH



PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT

**A PARTIAL LIST OF OUR INVENTORY**

| KW | MAKE | MODEL | HP | RPM |
|---|---|---|---|---|
| 1980 | Nordberg | TS-217 | 3000 | 225 |
| 1180 | Worthington | SEH-8 | 1685 | 360 |
| 1136 | Fairbanks Morse | 38D | 1600 | 720 |
| 1100 | General Motors | 16-278A | 1600 | 720 |
| 750 | General Motors | 12-567 | 1080 | 720 |
| 700 | Worthington | EE-8 | 1000 | 327 |
| *500 | General Motors | 8-278A | 750 | 720 |
| 500 | Baldwin | VO-8 | 750 | 514 |
| *500 | Alco | 6-12½x13T | 750 | 600 |
| 500 | General Motors | 8-567 | 720 | 720 |
| *480 | Worthington | DD-8 | 700 | 360 |
| *400 | Ingersoll-Rand | S-8 | 600 | 720 |
| *400 | Sterling | VDS-8 | 600 | 1200 |
| *350 | Baldwin | VO-6 | 510 | 450 |
| 320 | Superior | 60-S-6 | 460 | 450 |
| *320 | Enterprise | DSG-6 | 460 | 450 |
| 300 | General Motors | 8-268A | 450 | 1200 |
| 200 | General Motors | 8-268A | 350 | 900 |
| 167 | Ingersoll-Rand | S | 255 | 600 |
| *160 | Buckeye | 80 | 240 | 600 |
| *150 | Worthington | CC-4 | 225 | 450 |
| 100 | General Motors | 3-268A | 150 | 1200 |

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED
*—*indicates NEW unit.*

**ONE YEAR GUARANTEE!**

## ELECTRICAL EQUIPMENT
REBUILT N.I.S.A. STANDARDS

**AC Motors — 3 phase 60 cycle**

| HP | Speed | Make | Wdg. | Type & Dise. |
|---|---|---|---|---|
| 500(3) | 1800 | West | Syn. 2200 V. | PedBrgW/Exc |
| 450 | 1800 | AC | SC 2200 V. | AW-SB |
| 350 | 1800 | AC | SC 2200 V. | AW-SB |
| 200 | 1800 | GE | SC | K6333S TEFC |
| 150 | 1800 | GE | SR | M-6328 TEFC |
| 150 | 720 | Allis-Chal. | SR | AR Hoist |
| 150 | 750 | GE | SR (25 cy) | IM |
| 125 | 1200 | | SR | CW-772C |
| 125 | 1200 | AC | SR | ARY-BB |
| 100 | 3600 | Wagner | SC | 1913L-13B |
| 100 | 900 | GE | SR | MT-8B |
| 100 | 700 | West. | SC | CS-SSB |
| 100 | 725 | Allis-Chal. | SR (25 cy.) | ARY-3 Brg. |
| 100 | 900 | GE | Syn 2200 V. | TS-DC Exciter |
| 75 | 900 | West. | SR | CW-752C |
| 75 | 600 | GE | SR | IM |
| 75 | 600 | GE | SC 2200 V. | KT-558 |
| 60 | 1200 | West. | SC | CS505 Spl. Pr. |
| 60 | 1200 | GE | SC | I-K |
| 60(3) | 1200 | Allis-Chal. | SR | ARY-505 BB |
| 50 | 1800 | GE | SC | IK |
| 50 | 1800 | FM | SR | HY-BB |
| 50 | 1200 | GE | SR | MT-336 |
| 50 | 720 | CW | SC | SC |
| 50 | 600 | CW | SR | SR |
| 40 | 3600 | GE | SC | K-405eExp.Pr. |
| 40(2) | 1200 | Rel.&West. | SC | Fr. 445-RB |
| 40(2) | 1200 | AC&Rel. | SC | TEFC-BB |
| 40 | 900 | West. | SR | CW |
| 40 | 720 | AC | SR | ANY |
| 30(3) | 1800 | AC | SC | ARZ-TEFC |
| 30 | 1200 | AC | SC | ARZ-TEFC |

**SPECIALS**

2—333 KVA Penn. Transformers OISC 1/60—13800/2300.
1—500 KVA Trans. Westinghouse Type ASL. 5% Imp. 13800/480 volts 75° Air Cooled. 2—150 KW West. M-G Sets 275 V. DC 3/60/2300 AC. 2—56RZ Falk Motoreducers 125 RPM 50 HP Class II. Hundreds other motors and electrical items in stock. Large stock new motors to 150 hp & Gearheads to 30 hp at rated discount —Freight allowed. **SEND US YOUR INQUIRIES.**

## NATIONAL ELECTRIC SERVICE CO.

321 Lombard St., St. Louis 2, Mo. Phone — Chestnut 4603

**STORAGE & PRESSURE TANKS**

**Located Mich.-Mo.-Fla., N.J. & Conn.**

8—12,000-17,000 & 20,000 Gal. 100 Lb.
16—10,000-15,000 & 20,000 Gal. Storage
9—42,000, 120,000 & 240,000 Gal. Storage
10—10,000 Gal. Cap. RR Car Tanks

**LESTAN CORP., ROSEMONT, PA.**

**1000 KW DIESEL GEN. SET**

6 Cylinder, Air Start, Bosch Inj. System, Nelseco Diesel Engine, 300 RPM, direct coupled to: General Electric AC, 1000 KW, 3/60/2400 Volts, including: Starting Auxiliaries, Switchboard, and Spare Parts. Overhauled, ready to ship.

*Various other makes and sizes in stock, AC & DC Units.*

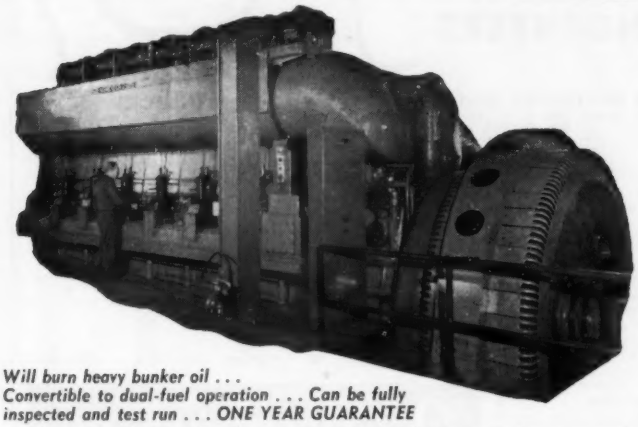
**ALJON ELECTRIC DIESEL CO.**

904-10 Pacific St. Brooklyn 38, N. Y.
STerling 3-6515

# CURRENT MODEL·· DIESEL

## 1980 KW NORDBERG MODEL TS-217 DIESEL UNIT

*Heavy Duty • Slow Speed • Available Immediately*



*Will burn heavy bunker oil . . .*
*Convertible to dual-fuel operation . . . Can be fully inspected and test run . . . ONE YEAR GUARANTEE*

ENGINE: (2800 BHP net) Nordberg, 7 cylinder, 2 cycle Diesel engine at 225 RPM, 21¼" bore, 29" stroke, cylinders arranged vertical in line, solid injection.

GENERATOR: 1980 KW, 2475 KVA General Electric generator, 2400/4160/6900 volts, 3 phase, 60 cycle service at 225 RPM.

*(50 cycle rating 1650 KW at 187 RPM)*

**UNIT AUXILIARIES AND ACCESSORIES**

Complete standard engine auxiliaries and accessories including filters, strainers, pumps, gauge board, pyrometer, thermocouples, exhaust muffler, lubricating oil cooler, Young evaporative type cooler for jacket water cooling, thermostatic control valve, fuel oil day tank with transfer pump and oil meter, 2 lubricating oil storage tanks, lubricating oil transfer pump, Diesel-driven air starting unit, air tanks, air intake filter, special engine tools, all station piping, including flanges, adapters, valves, and fittings, for air intake exhaust, water, lubricating oil, fuel oil, and air. Generator and exciter control switchgear.

The unit above affords a rare opportunity to procure a complete, modern current model, heavy duty, slow speed diesel set at a great saving. It represents an offering which cannot be duplicated anywhere in the diesel market today.

***Act now . . . Phone, Wire, or Write for Full Details***

***ALL OWNED AND OFFERED EXCLUSIVELY BY***

**TELEPHONE**
**DIGBY 9-4350**

**TELETYPE**
**NY 1-2804**

**A.G. SCHOONMAKER CO., INC.**

**"America's Largest Source of New and Remanufactured Diesel Power"**

***Western Union — WUX —***
**A. G. Schoonmaker Co.**
**Inc., N. Y.**
***CABLE:—AGSCOMACH***

**50 CHURCH ST., NEW YORK 7, N. Y.**

***Plants and Warehouses: Jersey City, N. J. and Sausalito (S.F.), California***

## COMPLETE POWER PLANTS

**STEAM — ELECTRIC — HYDRO — DIESEL**

***"Export Orders Carefully Executed"***

**TRY US with your INQUIRIES for ALL POWER MACHINERY**

**CHARLES B. REARICK** **30 CHURCH ST.** **NEW YORK 7, N. Y.**

## RENTAL OR SALE

EXISTING
**BOILERS**
10 TO 5000 HP — 10 TO 900 PSI
EXISTING
**DIESEL ENGINES — STEAM TURBINE GENERATORS**
5 TO 20,000 KW

**STRICKLER ENGINEERING CORPORATION**
5220 Pennington Ave., Baltimore 26, Md.
Curtis 7-2772

## COMPLETE STANDBY TURBINE GENERATING PLANT

***Consisting of:***

1500 KW G.E. Turbine
500 KW G.E. Turbine
Condensors, pumps and 4—300 HP Heine Boilers, switchboard & auxiliaries. Will sell all or any part. Also Two 1500 KW G.E. Rotary Convertors w/transformers. 145 HP Bros Boiler; 50 HP Cleaver-Brooks Boiler; 4—50 HP DC Elevator Motors 425/600 RPM. 2—8-268A General Motors Diesel Engines. *Send for our lists.*

**GENERAL MACHINERY & EQUIPMENT CO., INC.**
**809 Woodland, Kansas City, Mo.**
**Victor 0018**

## GUARANTEED REBUILT

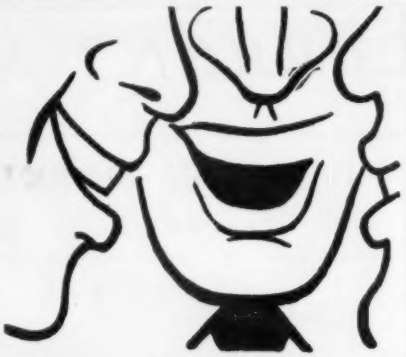
We offer the following slip ring motors. They are all 220 440 volt, 60 cycle, 3 phase. We can also furnish controls for these motors. This is a partial listing so CALL OR WIRE COLLECT for any other motor requirements.

| Quan | H.P. | Make | Type | Speed | Descrip |
|---|---|---|---|---|---|
| 1 | 300 | G.E. | I-M | 900 | S.B. |
| 1 | 150 | G.E. | I-M | 1200 | S.B. |
| 1 | 125 | G.E. | I-M | 720 | S.B. |
| 1 | 100 | G.E. | I-M | 1800 | S.B. |
| 1 | 100 | West. | CW | 1200 | S.B. |
| 1 | 100 | West. | CW | 900 | S.B. |
| 1 | 100 | G.E. | I-M | 720 | S.B. |

**POWER EQUIPMENT COMPANY**
**8 CAIRN ST., ROCHESTER 2, N. Y.**
**P. O. BOX 534 — Tel: Genesee 5629**

# Something to TALK ABOUT

## THE MONEY YOU SAVE ON EQUIPMENT GUARANTEED BY HEMPHILL ELECTRICAL ENGINEERS



*This seal says so!*

### TRANSFORMERS—60 Cycle

| Qu. | KVA | Make | Type | Ph | Voltages |
|---|---|---|---|---|---|
| 1 | 1500 | G.E. | Pyranol | 3 | 4150x2400 |
| 1 | 1000 | G.E. | Auto | 3 | 4150x2400 |
| 2 | 750 | G.E. | HT | 3 | 4150x120/240 |
| 2 | 750 | G.E. | H | 1 | 4600-120/240 |
| 1 | 500 | Kuhl. | OISC | 1 | 4150x2400 |
| 2 | 400 | Pitts. | OISC | 1 | 4800/4150/2400 x240/480 |
| 3 | 333 | Whse. | OISC | 1 | 2400x575 |
| 1 | 333 | G.E. | H | 1 | 13200x220 440 |
| 2 | 300 | G.E. | H | 1 | 13200x440 |
| 4 | 200 | G.E. | H | 1 | 13200x440 |
| 1 | 200 | G.E. | HT | 3 | 2400x240 |
| 2 | 150 | Pitts. | ODSC | 1 | 240x120/240 |
| 3 | 50 | G.E. | H | 1 | 4800x120/240 |
| 3 | 50 | A.C. | H | 1 | 230x120/240 |
| 1 | 25 | G.E. | H | 1 | 460x120/240 |
| 1 | 20 | G.E. | Novalux | | 2400 6.6 Amps |
| 2 | 25 | G.E. | H | 1 | 575x115/230 |
| 3 | 25 | Nlag. | OISC | 1 | 2400x480 |
| 3 | 25 | Watzhse | SK | 1 | 440/220/110 |

### MOTOR GENERATOR SETS

| Qu. | KW | Make | Speed | DC | AC |
|---|---|---|---|---|---|
| 1 | 1000 | G.E. | 514 | 600 | 2300/4150 3ph. |
| 1 | 1000 | Whse. | 720 | 600 | 2300/4150 3ph. |
| 1 | 1000 | Whse. | 720 | 275 | 2300/4150 3ph. |
| 1 | 300 | C.W. | 1200 | 230 | 3-unit 2400/4150&R |
| 1 | 300 | G.E. | 1200 | 230 | 2400/4150&R |
| 1 | 200 | Whse. | 900 | 250 | 2300/4150 3ph. |
| 1 | 150 | C.W. | 1200 | 230 | 440 SC |
| 1 | 150 | 3 Unit G.E. | 1200 | 125/250 | 2300 3ph. |
| 1 | 150 | Whse. | 600 | 125 | 4150 3ph. |
| 1 | 125 | C.W. | 1200 | 125 | 2300 S.C. |
| 1 | 100 | G.E. | 900 | 250 | 2300 3ph. |
| 3 | 60 | G.E. | 1200 | 125 | 208 3ph. |
| 2 | 30 | G.E. | 1200 | 125 | 440 SC |

### SYNCHRONOUS MOTORS

| Qu. | H.P. | Make | Speed | Type | Volts |
|---|---|---|---|---|---|
| 1 | 300 | El. Mach. | 720 | TEFC | 2300 |
| 3 | 200 | Whse. | 720 | | 4150 |
| 1 | 175 | G.E. | 720 | ATI | 2300 |
| 1 | 150 | G.E. | 720 | ATI | 2300 |
| 1 | 150 | G.E. | 1800 | TS | 220 |
| 1 | 150 | Whse. | 900 | 181G | 220 |

**RECTIFIER**

500 KW, 250 V. D.C. Allis-Chalmers, 2000 Amp. Type 6-ES-12. 599 KVA, 13,200 volts to 244 volts neutral. 6 phase. New 1951. Magna Blast.

### SLIP RING MOTORS

| Qu. | H.P. | Make | Speed | Type | Volts |
|---|---|---|---|---|---|
| 2 | 500 | G.E. | 1200 | M | 2400/4150 |
| 1 | 400 | Whse. | 450 | CW | 550 |
| 1 | 250 | Whse | 600 | CW | 440 |
| 1 | 200 | Whse. | 600 | CW | 440 |
| 1 | 200 | G.E. | 600 | MT | 440 |
| 3 | 150 | A.C. | 1800 | AY RW | 2300 |
| 1 | 100 | G.E. | 1800 | IM | 220 |
| 1 | 100 | G.E. | 600 | IM | 440 |
| 1 | 75 | G.E. | 900 | IM | 440 |
| 1 | 60 | G.E. | 1800 | MT | 220 |

### DC, 230 VOLT MOTORS

| Qu. | H.P. | Make | Speed | Type |
|---|---|---|---|---|
| 1 | 300 | G.E. | 1200 | MPC |
| 2 | 150 | C.W. | 900 | WP |
| 1 | 125 | G.E. | 1700 | RC |
| 2 | 75 | C.W. | 900 | WP |
| 1 | 30 | C.W. | 700 | CM |
| 1 | 35 | G.E. | 860 | RC |
| 1 | 35 | Whse. | 835 | SK |

"FOR POWER"

J.L. HEMPHILL & CO.

1603 54th STREET, NORTH BERGEN, N. J.

PHONE NEW YORK—LONGACRE 5-1237

PHONE NEW JERSEY—UNION 7-2600

*Member of The National Industrial Service Association, Inc.*



**MOTORS — GENERATORS — TRANSFORMERS**
**MOTOR GENERATOR SETS — CONTROLS —**
**COMPLETE VARIABLE VOLTAGE DRIVES**

*30 YEARS (1924-54)*
*SERVING INDUSTRY*

**BUY FROM ONE OF AMERICA'S LARGEST STOCKS**

**SAVE $$$$ ON YOUR PURCHASES**

### SQUIRREL CAGE MOTORS
3 Phase, 60 Cycle

| Qu. | H.P. | Make | Type | Volts | R.P.M. |
|---|---|---|---|---|---|
| 1 | 400 | Cont. | NZ-806-S | 2300 | 1200 |
| 1 | 400 | G. E. | 1-K | 2200 | 514 |
| 1 | 300 | Whse. | CS-890 | 2300 | 1750 |
| 1 | 200 | Whse. | CS-873-C | 2200 | 1160 |
| 1 | 300 | Al. Ch. | AR | 440/220 | 580 |
| 2 | 125 | Al. Ch. | AR | 2300 | 1750 |
| 1 | 125 | Al. Ch. | AR | 2300 | 490 |
| 1 | 100 | Whse. | CS-863-C | 440 | 1750 |
| 1 | 100 | G. E. | KT-562 | 440/220 | 570 |
| 1 | 100 | Whse. | CS-938 | 2200 | 495 |
| 1 | 100 | F. M. | H-241B | 440 | 435 |

### MOTOR GENERATOR SETS

| Qu. | KW | Make | RPM | V. DC | V. AC |
|---|---|---|---|---|---|
| 1(3U) | 2100 | Whse. | 720 | 600 | 4800/2400 |
| 2 | 1100 | Whse. | 720 | 600 | 2300 |
| 3 | 1000 | Whse. | 514 | 600 | 11000/6600 |
| 2 | 500 | C. W. | 720 | 575 | 2300 |
| 1 | 400 | C. W. | 720 | 250 | 2300 |
| 1 | 400 | C. W. | 1200 | 125/250 | 440/2300 |
| 1 | 300 | Whse. | 1200 | 275 | 2200 |
| 1 | 200 | Whse. | 1200 | 275 | 4000/2300 |
| 1 | 200 | Whse. | 1200 | 600 | 4000/2300 |
| 2 | 150 | Whse. | 1200 | 250 | 440 |
| 1 | 155 | G. E. | 720 | 250 | 2300/440 |
| 1 | 100 | Ridgeway | 1200 | 275 | 4000/2300 |
| 1 | 100 | C. W. | 1200 | 125 | 440/220 |
| 1 | 85 | C. W. | 1200 | 250 | 4000/2300 |
| 1 | 75 | Al. Ch. | 900 | 250 | 2300 |
| 1 | 25 | Ideal | 1750 | 125 | 440/220 |
| 2 | 25 | Al. Ch. | 1200 | 250 | 440/220 |
| 3 | 20 | Al. Ch. | 1200 | 250 | 440/220 |

Any of these sets can be furnished with D.C. panels and starting equipment.

### SLIP RING MOTORS
Constant Duty, 3 Phase, 60 Cycle Type

| Qu. | H.P. | Make | Type | Volts | R.P.M. |
|---|---|---|---|---|---|
| 1** | 1800 | G. E. | MT-498 | 2300 | 357 |
| 1** | 1200 | G. E. | MT-26 | 2200 | 277 |
| 2 | 800 | G. E. | MT | 2200 | 440 |
| 1 | 700 | G. E. | I-M | 2300 | 400 |
| 1** | 600 | G. E. | MT-20 | 2300 | 360 |
| 1** | 500 | Al. Ch. | ANY | 2200 | 514 |
| 2 | 500 | G. E. | I-16-M | 2300 | 450 |
| 2 | 400 | G. E. | MT-412 | 2200 | 450 |
| 1 | 250 | Whse. | CW-937 | 440 | 1200 |
| 1 | 250 | G. E. | MT-414 | 2200 | 300 |
| 1 | 250 | Al. Ch. | ARY | 440 | 720 |
| 2 | 100 | G. E. | I-15-M | 2300 | 514 |

**—Pedestal bearing design.

### SYNCHRONOUS MOTORS
3 Phase, 60 Cycle

| Qu. | H.P. | Make | P.F. | Volts | R.P.M. |
|---|---|---|---|---|---|
| 1 | 4350 | C. W. | 80 | 13200/6600 | 514 |
| 1 | 3000 | Whse. | 80 | 4800/2400 | 720 |
| 2 | 2100 | G. E. | 100 | 2300 | 360 |
| 2 | 2000 | G. E. | 80 | 2300 | 720 |
| 2 | 1750 | G. E. | 100 | 2200 | 3600 |
| 1 | 750 | G. E. | 80 | 2300 | 450 |
| 1 | 710 | G. E. | 80 | 2300 | 720 |
| 2 | 600 | G. E. | 80 | 2300 | 600 |
| 1 | 250 | G. E. | 100 | 2300 | 514 |
| 2 | 200 | Whse. | 80 | 440 | 1200 |
| 1 | 187 | G. E. | 80 | 440 | 720 |
| 1 | 160 | G. E. | 100 | 2200 | 900 |
| 1 | 150 | G. E. | 100 | 550 | 600 |
| 1 | 150 | Whse. | 80 | 440/220 | 450 |
| 2 | 135 | G. E. | 80 | 4000/2200 | 1200 |
| 3 | 125 | El. Mchy. | 100 | 4800/2400 | 900 |
| 1 | 125 | G. E. | 8 | 2300 | 900 |
| 2 | 100 | Whse. | 8 | 440 | 1800 |
| 1 | 100 | Ideal | 8 | 440/220 | 900 |
| 2 | 100 | G. E. | 8 | 440/220 | 600 |

We have a large stock of manual magnetic and semi-magnetic, reduced and full voltage control for use with these motors.

### DIRECT CURRENT MOTORS
(230-VDC)

| Qu. | H.P. | Make | Type | R.P.M. |
|---|---|---|---|---|
| 6* | 3000 | Whse. | Mill | 600 |
| 14* | 1500 | Whse. | Mill | 600 |
| 10* | 800 | Whse. | Mill | 600 |
| 8 | 700 | Whse. | Mill | 350/700 |
| 1 | 350 | G. E. | CD-169 | 1150 |
| 1 | 250 | G. E. | MPC | 325/975 |
| 1 | 200/250 | G. E. | MPC | 300/900 |
| 1 | 200/250 | El. Dy. | Size 22 | 400/1200 |
| 1 | 200 | Whse. | Mill | 300/1200 |
| 1 | 180 | G. E. | MPC | 400 |
| 1 | 160/90 | G. E. | MPC | 625/1125 |
| 1* | 125 | Whse. | SK-190 | 600 |
| 2 | 125 | Whse. | SK-184 | 575/850 |
| 6 | 100 | El. Dy. | 30-S | 450/1100 |
| 5 | T.E.F.C. 75 | C. W. | H-53 | 860 |
| 1 | 50 | Whse. | SK | 250/1000 |
| 1 | 40 | Whse. | SK-140 | 500/1700 |
| 1 | 35 | G. E. | CD-125 | 400/1200 |
| 1 | 35 | G. E. | CD-147 | 300/1200 |

**SAVE 50% — Immediate Shipment — REBUILT — GUARANTEED 4500 K.V.A. Gen'l Elec. Transformer 3 ph., 60 cy., Serial 6800048 27000/13500 (4-2½% taps)— 2300 V., expansion tank, external tube radiator oil cooling.**

*PURC. AGENTS—PLT. SUPT.—PLT. ENGR. "MAY WE SEND YOU OUR CATALOG 5537"*

# T. B. MAC CABE COMPANY

4314 CLARISSA STREET — Phone DAvenport 4-8300 — PHILADELPHIA 40, PENNA.

## AC MOTORS

| HP | Make | Type | Volt | Speed |
|---|---|---|---|---|
| 150 | West. | CS | 220–440 | 1750 |
| 125 | West. | CCL | 2200 | 1140 |
| 100 | American | | 220–440 | 1750 |
| 75 | A. C. | AR | 220–440 | 1750 |
| 60 | Woods | B | 220–440 | 1200 |
| 60 | West. | CS | 220–440 | 690 |

## AC SLIP RINGS

| | | | | |
|---|---|---|---|---|
| 112 | G. E. | ITC 5015 | 220–440 | 495 |
| 75 | A. C. | ARY | 220–440 | 1750 |
| 60 | G. E. | MT 343 | 220–440 | 1200 |
| 50 | G. E. | MT 343 | 220–440 | 1200 |
| 50 | G. E. | MT 336 | 220–440 | 1200 |
| 50 | West. | CI 654D | 220–440 | 690 |
| 40 | Howell | SR 504 | 220–440 | 900 |
| 40 | Howell | SR 504 | 220–440 | 900 |

## SYN MOTOR

| | | | | |
|---|---|---|---|---|
| 75 | West. | G | 440 | 720 Dir. Con. Exc. |
| 50 | G. E. | TS7558 | 440 | 1200 Dir. Con. Exc. |
| 40 | G. E. | TS7542 | 440 | 900 Dir. Con. Exc. |

## DIESEL GENERATOR SETS

| | | | | |
|---|---|---|---|---|
| 200 KW | Ideal | 240 | 3–60 | 327 |

## VENN-SEVERIN Model M Engine

| | | | | |
|---|---|---|---|---|
| 125 KW | Ideal | 240 | 3–60 | 327 |

## TRANSFORMERS

| | | | | |
|---|---|---|---|---|
| 3—1000 | KVA | G. E. | 13,800 | 6900 1 ph. 60 cy |
| 5— 100 | KVA | Mol. | 220 volt | 11–11–12–14 16–18–20 |
| 1—75 | KVA | G. E. | 13,200 | 120–240 1 phase |
| 2—50 | KVA | G. E. | 12,000 | 120–240 1 phase |
| 1—50 | KVA | West. | 7,200 | 120–240 1 phase |
| 6—25 | KVA | G. E. | 440–110 | 1 phase Dry Type |
| 1—37½ | KVA | Penn. | 1,200 | 120–240 1 phase |
| 1—37½ | KVA | West. | 7,200 | 240–120 |
| 1—37½ | KVA | West. | 6,900 | 115–230 |
| 10— 5 | KVA— | West. | 13,800 | 115–230 |

## 1000

3 KW, 3 Phase, 120 volt, AC Hobart Gas Engine Generator Sets. Skid Mounted. Panel and Starter. Outside inclosure. NEW

JOSEPH BEHR & SONS INC
1246 SEMINARY STREET
ROCKFORD, ILLINOIS

RE-NU-BILT BELYEA MOTORS

# THE TRADE MARK WITH A MEANING SUCCESSFUL OPERATION GUARANTEED

*45th Year of Service—Member of A.R.A. and N.I.S.A.*

## A. C. MOTORS

### 3 ph. 60 Cycle

### SYNCHRONOUS

| Qu. | HP | Make | Type | Volts | Speed |
|---|---|---|---|---|---|
| 1 | 4350 | Cr. Wh. | | 4160/13800 | 514 |
| 2 | 3500 | G. E. | TS | 2300 | 257 |
| 1 | 2500 | G. E. | ATI | 2300 | 720 |
| 2 | 2100 | G. E. | ATI | 2300 | 360 |
| 2 | 2000 | Whse. | | 2300 | 120 |
| 1 | 2000 | G. E. | ATI | 2200 | 900 |
| 2 | 1750 | G. E. | ATI | 2300 | 3600 |
| 3 | 735 | G. E. | ATI | 2200/12000 | 600 |
| 1 | 720 | G. E. | TS | 2200 | 720 |
| 1 | 500 | Ideal | SM | 2300/4150 | 1800 |
| 1 | 450 | Whse. | Eng. | 2200 | 128.5 |
| 1 | 450 | Whse. | | 2300 | 450 |
| 1 | 400 | G. E. | TS-6424 | 2200 | 400 |
| 2 | 350 | G. E. | TS | 2200 | 150 |
| 1 | 300 | Whse. | | 2300 | 720 |
| 1 | 150 | Whse. | | 440 | 600 |

### SLIP RING

| | | | | | |
|---|---|---|---|---|---|
| 1 | 1500 | G. E. | MT-498 | 2300 | 360 |
| 1 | 1500 | ABB | | 2300 | 720 |
| 1 | 1200 | G. E. | MT-26 | 2300 | 275 |
| 2 | 1000 | A. C. | Mill | 2300 | 240 |
| 1 | 1000 | G. E. | MT-452 | 2200 | 321 |
| 1 | 500 | Whse. | CW | 550 | 360 |
| 1 | 500 | G. E | M-574Y | 2200 | 900 |
| 1 | 450 | G. E. | IM | 440 | 720 |
| 1 | 400 | Whse | CW-1218 | 2200 | 435 |
| 1 | 400 | Whse | CW | 440 | 514 |
| 1 | 400 | Whse. | CW-960A | 440 | 1170 |
| 1 | 350 | G. E. | MT-442 | 2300/4000 | 253 |
| 1 | 350 | G. E. | IM-17A | 440/2300 | 720 |
| 1 | 250 | G. E. | MT-424Y | 4000 | 250 |
| 1 | 250 | G. E. | MT-559S | 2200 | 1750 |
| 1 | 250 | A. C. | | 550 | 600 |
| 1 | 200 | Cr. Wh. | 26QB | 440 | 505 |
| 1 | 200 | G. E. | IM | 440 | 435 |
| 1 | 200 | G. E. | MTP | 440 | 1170 |
| 1 | 150 new | Whse. | CW | 2300 | 450 |
| 1 | 150 | G. E. | IM-16 | 440 | 600 |
| 2 | 125 | A. C. | | 440 | 865 |
| 1 | 125 | A. C. | | 440 | 720 |
| 4 | 125 | G. E. | MT-566Y | 440/2200 | 435 |
| 2 | 100 | G. E. | IM | 440 | 600 |
| 1 | 100 | G. E. | IM | 2200 | 435 |
| 4 | 100 | A. C. | | 440 | 695 |
| 4 | 100 | G. E | MT | 440/2200 | 435 |

### SQUIRREL CAGE

| | | | | | |
|---|---|---|---|---|---|
| 2 | 650 | G. E. | FT559BY | 440 | 3750 |
| 2 | 450 | Whse. | CS | 2300/4150 | 354 |
| 1 | 300 | Whse. | CS | 440 | 1170 |
| 1 | 200 | G. E. | IK-17 | 440 | 580 |
| 3 | 200 | G. E. | KT-557 | 440 | 1800 |
| 1 | 75/150 | G. E. | IK | 440 | 450/900 |
| 1 | 150 | Whse. | CS | 440 | 580 |
| 1 | 150 | Westghse. | CS856S | 440 | 880 |
| 1 | 125 | Whse. | MS | 440 | 485 |
| 2 | 125 | Al. Ch. | ARW | 2200 | 1750 |
| 2 | 100 | G. E. | IK | 440 | 580 |

## D. C. MOTORS

| Qu. | HP | Make | Type | Volts | Speed |
|---|---|---|---|---|---|
| 1 | 2200 | G. E. | MCF | 600 | 360/500 |
| 1 | 2000 | Whse. | Mill | 600 | 230/460 |
| 1 | 940 | Whse. | QM R Brg. | 250 | 140/170 |
| 1 | 900 | Whse. | | 250 | 450/550 |
| 1 | 825 | Whse. | Mill | 250 | 90/180 |
| 1 | 600 | A. Ch. | Mill | 230 | 400/800 |
| 1 | 500 | Whse. | Mill | 600 | 300/900 |
| 2 | 450 | Whse. | | 550 | 415 |
| 1 | 400 | G. E. | MCF | 550 | 300/1050 |
| 1 | 300/400 | G. E. | DYNA | 250 | 1325/2500 |
| 1 | 300 | Whse. | CB-5094 | 230 | 575/1150 |
| 1 | 200/300 | G. E. | MPC | 230 | 360/920 |
| 1 | 250 | G. E. | MPC | 230 | 400/500 |
| 1 | 200 | Rel. | 1970T | 230 | 720 |
| 1 | 200 | Whse. | CB-5113 | 230 | 400/800 |
| 1 | 150 | G. E. | | 600 | 250/750 |
| 8 | 150 | Cr. Wh. | 83H | 230 | 890 |
| 1 | 150 | Cr. Wh. | CMC-65H | 230 | 1150 |
| 1 | 150 | Whse. | SK-201 | 230 | 360/950 |
| 1 | 150 | Whse. | SK-151 B | 230 | 900/1800 |
| 1 | 125(new) | Whse. | SK-183 | 230 | 850 |
| 1 | 125 | G. E. | MDS-416 | 230 | 415 |
| 1 | 75 | C. W. | 53H-TEFC | 230 | 860 |
| 1 | 75 | Whse. | SK-170 | 230 | 600/1200 |
| 1 | 50/120 | G. E. | MFC | 230 | 250/1050 |
| 2 | 100 | Whse. | SK-181 | 230 | 450/1000 |
| 4 | 60 | El. Dy. | 25-8 | 230 | 525/1050 |
| 2 | 50/60 | Whse. | SK-170 | 230 | 400/1200 |
| 1 | 50 | G. E. | CO-1810 | 230 | 725 |
| 1 | 50 | Whse. | SK-170 | 230 | 350/1050 |
| 1 | 50 | G. E. | RCF-31B | 230 | 1700 |
| 2 | 40/50 | G. E. | CD-135 | 230 | 300/1200 |

## MOTOR GENERATOR SET

### 3 Ph. 60 Cycle

| Qu. | KW | Make | Speed | D.C. Volts | A.C. Volts |
|---|---|---|---|---|---|
| 1 | 3000 (3U) | G. E. | 514 | 600 | 4000/13200 |
| | 2000 | G. E. | 514 | 600 | 13800/4000 |
| 2 | 2000 | G. E. | 450 | 250 | 2400 |
| 1 | 2000(25 cy) | G. E. | 500 | 660 | 6600/11000 |
| 2 | 1750 | G. E. | 514 | 250 | 2400 |
| 1 | 1500 | G. E. | 720 | 600 | 6600/13200 |
| 1 | 1500 | C. W. | 514 | 115 | 4160/13800 |
| 2 | 1000 | Whse. | 900 | 600 | 2300/4100 |
| 1 | 1000 | G. E. | 900 | 260 | 6600 |
| 1 | 1000(3U | G. E. | 900 | 250 | 2400/4800 |
| 2 | 750 | Whse. | 900 | 275 | 2300/4160 |
| 1 | 750 | C. W. | 514 | 115 | 2300 |
| 1 | 600 | G. E. | 720 | 250 | 440/2300 |
| 1 | 500 | Whse. | 900 | 125/250 | 440 |
| 1 | 500 | Whse. | 1200 | 125/250 | 2300 |
| 1 | 500 | G. E. | 720 | 125 | 2300/4000 |
| 1 | 400 | G. E. | 720 | 250 | 440/2300 |
| 1 | 150 | G. E. | 1200 | 250 | 2300 |
| 1 | 150 | Whse. | 1200 | 275 | 2300 |
| 1 | 150 | G.E. | 1175 | 125 | 440 |
| 1 | 140(3U) | Cr. Wh. | 690 | 125-250 | 2 300 |
| 1 | 125 | G. E. | 1200 | 125 | 440 |
| 1 | 100 | Delco | 1200 | 125/250 | 440 |
| 1 | 100 | G. E. | 1200 | 250 | 2300/4000 |

### 12,500 KW 60 to 25 CYCLE FREQUENCY CHANGER—IMMEDIATE SHIPMENT

Westinghouse 300 R.P.M. 4 Bearing frequency changer set. Motor 17200 H.P. .7 P.F., 13200 Volt, 3 ph., 60 cy., Generator 13900 K.V.A., 12500 KW .9 P.F. 13200 volt, 3 phase, 25 cycles, with 2 direct connected 125 volt exciters, complete including motor operated phase shifter, air washer; 60 and 25 cycle controls—Prints, performance guarantees and complete details available—Can be inspected in operation.

## FREQUENCY CHANGERS

| Qu. | KW | Make | Cycles | Voltage |
|---|---|---|---|---|
| 1 | 3000 | G. E. | 25/60 | 4000/2300x2300/4000 |
| 1 | 2500 | G. E. | 25/60 | 2400x4150 |
| 1 | 2000 | G. E. | 25/62½ | 2300/4160 |
| 1 | 2000 | Whse. | 25/62½ | 2300/2300 |
| 1 | 1000 | G. E. | 25/58 | 4400/2300 |
| 1 | 500 | A. C. | 25/60 | 11000/2300V |

## TURBO GENERATORS

| Qu. | KW | Make | Desc. |
|---|---|---|---|
| 1 | 4000 | G. E. | Condensing 425 — 750°F.T.T Surface Condenser 3/60/2300/4000V Direct conn exciter |
| 1 | 1000 | Moore | Auto - Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300. |
| 1 | 1000 | G. E. | Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60. |
| 1 | 750 | G. E. | Condensing 265# I.S.P. 440V. 3 ph. 60 cy.—New—1944 |
| 1 | 750 | Whse. | —Non-condensing 135# I.S.P. 40# B.P. 750 Kw. 280 V. D.C. |
| 1 | 500 | Moore | Non-condensing—150/200 lbs. I.S.P. 5/35 lbs. G.B.P.—3/60/480 volts direct connected exciter. |
| 2 | 500 | G. E. | Non-condensing 175/200 lbs. I.S.P., 5/30 G.B.P., 480/3/60 |
| 1 | 300 | G. E. | Non-condensing 10/175# I.S P. 5/15# B.P. 480V. 3 ph. 60 cy |

## TRANSFORMERS

### 60 Cycles

| Qu. | KVA | Make | Type | Ph | Voltages |
|---|---|---|---|---|---|
| 1 | 5000 | Whse. | OISC | 3 | 3300x26400/13200 |
| 1 | 3500 | G. E. | WCT | 3 | 13800/6900x2300/440 |
| 1 | 2500 | Whse. | OISC | 3 | 26400/13200x460 |
| 3 | 2000 | G. E. | HVDDJ | 1 | 66000x13800 |
| 2 | 1750 | G. E. | WCT | 3 | 13800/6900x2300/410 |
| 3 | 1000 | G. E. | H | 1 | 2200x480 |
| 1 | 1500 | G. E. | HT | 3 | 13200x2300 |
| 3 | 1250 | G. E. | H | 1 | 7600x550 |
| 2 | 1000 | Pitts. | OISC | 3 | 2300x460 |
| 4 | 1000 | Al. Ch. | OISC | 1 | 2300/4000x460 |
| 3 | 1000 | Wagner | OISC | 1 | 13200x220/440 |
| 1 | 300 | Kuhl | OISC | 3 | 13800x460 |
| 3 | 200 | Whse. | OISC | 1 | 13200x120/240 |
| 3 | 150 | Whse. | OISC | 1 | 33000x2300/4000 |
| 6 | 150 | G. E. | HKR | 1 | 13200x2300/4000 |
| 3 | 100 | Whse. | S | 1 | 480/120/240 |

# BELYEA COMPANY, INC.

*OFFICE AND SHOP*

43 HOWELL ST., JERSEY CITY 6, N. J.

PHONE JO 2-3334 — N. Y. CITY LINE RE 2-7150

# MOTORS • GENERATORS • TRANSFORMERS

### N.E.M.A. FRAME MOTORS

2—10 HP A.C. ARX-324 1800
1—10 HP West. CS-324 1800
1—10 HP F.M. FW-326 1170
1—15 HP G.E. K 326 1800
1—15 HP C.W. SC-A365 1170
1—20 HP L.A. X-Proof 365 1800
1—20 HP West. CS-W364 1750
1—20 HP West. CS 365 1170
2—20 HP West. CS-404 1165
1—25 HP G.E. TEFC K365 1760
1—25 HP West. CS-365 1760
1—25 HP U.S. SC-364 1800
1—25 HP G.E. TEFC KG405 1170
1—25 HP G.E. K404 1170
1—25 HP G.E. K-405 900
1—30 HP Delco TEFC-405 1745
1—40 HP West. CS-404 1800
1—50 HP Ideal TEFCBB 1800
1—50 HP G.E. K-504 1200
1—75 HP West. CS 1200
1—100 American E3 3460

1—350 KW General Electric Generators Type MPC, 250 Volt DC, 720 RPM Single Bearing Machines.

### 25 CYCLE MOTOR SPECIALS

1— 40 HP Reliance TEFC BB 3/25/220/440/1500 RPM.
1— 50 HP Fairbanks Morse BB 3/25/220/440/750 RPM.
1—100 HP Gen. Elect. Type KT 553 3/25/440/1445 RPM.
1—100 HP Gen Elect. Type KT 5595 Ball Bearing 3/25/440/1465 RPM.
2—150 HP Gen. Elect. Type KT565 TEFC BB—3/25/440/750 RPM.

### MOTORS

60-50-25 Cycle in Stock—All Sizes. Slipring—Squirrel Cage—Synchronous. All types of Control Equipment.

100 HP Gen. Electric Type I form K 3/60/2300/600 RPM.

100 HP Gen. Electric Type KT 356 3/60/2200/900 RPM.

125 HP Gen. Electric Type I form K 3/60/440/720 RPM.

125 HP G. E. Type KT 3/60/2300/1200 RPM

150 HP G. E. Type KT 3/60/440/500 RPM.

150 HP Gen. Electric Type I form K 3/60/2300/900 RPM.

### 400 HP GEAR REDUCER

1—400 HP Nutall (Westinghouse) Type LMR-25 Single Helical Heavy Duty Reducer—6-1 Ratio at 900 RPM with High Speed Shaft Extension for Brake.

### 400 HP SYNCH. MOTOR

1—400 HP Westinghouse Synchronous Motor. 3/60/2300/900 RPM. Unity P.F. with direct connected exciter—Late Type.

### 55" LIFTING MAGNET

1—55" Cutler Hammer Magnet 250 Volts DC. Excellent Condition.

### 125 VOLT DC MOTOR

1—100 HP Crocker Wheeler 125 Volt DC 850 RPM Ball Bearing

### DC CIRCUIT BREAKERS

1—1000 AMP. Condit. 2 Pole
1—1600 AMP. Condit. 2 Pole
1—1600 AMP. Westinghouse 2 Pole
1—3000 AMP. Westinghouse 2 Pole

### TRANSFORMERS

1—750 KVA Niagara New. Outdoor 3/60/2400/208Y/120.
3—500 KVA Westinghouse Type SL. 1/60/33000/2400/4160Y—New 1947.
3—333 KVA Westinghouse O.I.S.C. 1/60/4800/480.
1—75 KVA Gen. Elect. Dry Type 1/60/480—240.
6—50 KVA Niagara New Dry Type 1/60/240/480—120/240.
1—20 KVA Gen. Elect. Dry Type 1/60/480—120.

**ERIE ELECTRIC CO., INC.** 124 CHURCH ST. BUFFALO, N. Y. CL. 4758

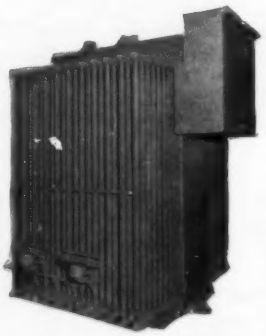
# TRANSFORMERS

**SAVE MONEY**
**REBUILT — GUARANTEED**

**DISTRIBUTION TRANSFORMERS**
**1 Phase 60 Cycle**

3—3333 KVA 66000 to 33000 & 13200 v.
2—1000 KVA 13200—2300 v.
3— 500 KVA 38100/66000Y—2300 v.
3— 500 KVA 33000 v.—2300 v.
4— 500 KVA 13200 v.—2300 v.
4— 200 KVA 33000 v.—2300/4160Y
5— 200 KVA 13200—2300/4160Y
1— 200 KVA 12000—2300/4160Y
3— 200 KVA 7620/13200Y—2300
1— 150 KVA 66000—2300/4160Y
14— 100 KVA 33000—2300/4160Y
9— 100 KVA 13200—2300/4160Y
6— 100 KVA 7620/13200Y—2300/4160Y
3— 75 KVA 460—120/240
3— 75 KVA 2400—230/460
2— 50 KVA 60000—2300 v.
1— 50 KVA 6600/11400Y—2300
3— 50 KVA 13200Y—2300 v.
1— 25 KVA 13200Y—240/480
1— 25 KVA 7200/12470Y—240/480
3— 25 KVA 400/4160Y—120/240
3— 25 KVA 2400—230/460

8—15 KVA 67—5 KVA
62—10 KVA 26—3 KVA
71—7½ KVA 15—1½ KVA



2500 KVA 3 Phase 60 Cycle
General Electric Pyranol Filled
11500 to 480 V — Indoor — Taps

**CHECK OUR STOCK FOR**

- Outdoor Disconnects
- Oil Circuit Breakers
- Fuse Cutouts
- Voltage Regulators

# TRANSFORMERS

**SAVE TIME**
**FAST SHIPMENT FROM STOCK**

**OUTDOOR INSTRUMENT TRANSFORMERS**

2—110000/66000-110 v. 200 VA West. P.T.
3—34500-115 V. 200 V.A. West. P.T.
9—33000-110 V. 200 VA GE P.T.
2—60/120—5 A. 37 KV G.E. C.T.

**INDOOR INSTRUMENT TRANSFORMERS**
**LARGE STOCK**
**Potential & Current Transformers Ready to Go.**

**MISCELLANEOUS TRANSFORMERS**

7—25 KVA 450-117 v. 1/60 cy. West. Dry Type
1—7½ KVA 230/460-115/230 v. 1/60 cy. Moloney Dry Type.
8—6.6 amp Const. Current 2 KW 240 v. General Electric type RO
3—Ignition Transformers 115 v. 60 cy. 200 VA France Co.
8—Novulux Controllers—G.E. CR-7841-GB2 230/2300 v. 120 v. 60 cy. Line amps. 100/50

**WE WILL REWIND ANY OF THESE TRANSFORMERS TO YOUR SPECIFICATIONS**

## TAMPA ARMATURE WORKS INC.

401 S.MORGAN ST. TAMPA, FLORIDA PHONE 2-1966

# POWER EQUIPMENT

## TURBINE UNITS

1—2500 KVA G.E. 3/60/480 V. 3600 RPM NON-CONDENSING Nozzled for 150 psig.
1—1250 KVA Al. Ch. 3/60/480 V. 3600 RPM, Terry EXTRACTION turbine nozzled 250 psig 550° TT 40,000# extr. 25 psig. Surf. Cond.
1—938 KVA West. 3/60/480 V. 3600 RPM Terry EXTRACTION turbine nozzled 250 psig. 500° TT 10,000# extr. 50 psig. Surf. Cond.
1—375 KVA G.E. 3/60/480 V. 3600 RPM NON-CONDENSING 150 psig. 5-10 psig BP.

## MOTOR GENERATOR SETS—60 CY.

| QU. | KW | MFR. | V.—DC | A.C. | RPM |
|---|---|---|---|---|---|
| 1 | 3000 | G.E. | 250 | 13200 | 514 |
| 1 | 1500 | G.E. | 600 | 4150 | 600 |
| 1 | 200 | West. | 275 | 2200 | 900 |
| 2 | 150 | G.E. | 250 | 2300 | 1200 |
| 1 | 75 | Ridgway | 125 | 220 | 1200 |

## SYNCHRONOUS MOTORS

| QU. | HP | MFR. | VOLTAGE | RPM |
|---|---|---|---|---|
| 2 | 2000 | West. | 13200 | 1200 |
| 2 | 700 | West. | 2300 | 200 |
| 1 | 600 | G.E. | 2300 | 240 |
| 1 | 300 | G.E. | 2300 | 600 |
| 1 | 300 | West. | 2300 | 900 |
| 2 | 250 | G.E. | 2300 | 257 |
| 1 | 200 | G.E. | 2300 | 900 |

## FREQUENCY CHANGERS

| QU. | KVA | MFR. | CYCLES | RPM |
|---|---|---|---|---|
| 1 | 12500 | G.E. | 25/60 | 300 |
| 1 | 3750 | G.E. | 25/60 | 300 |
| 1 | 2500 | G.E. | 25/62½ | 750 |
| 1 | 1875 | A.C. | 60/25 | 300 |
| 1 | 1700 | West. | 60/24 | 720 |
| 1 | 500 | G.E. | 25/60 | 300 |

## OIL CIRCUIT BREAKERS—Outdoor

4— 800 A. 132 KV West. G-222A-2500 MVA
1— 400 A. 73 KV Condit FO-40-250 MVA
2— 400 A. 37 KV G.E. FHKO-136-350 MVA
4— 600 A. 15 KV G.E. FHKO-139-750 MVA
1—1200 A. 15 KV G.E. FKO-139-350 MVA
7— 600 A. 15 KV G.E. FK-155-28-350 MVA I/D

## TRANSFORMERS

| | | |
|---|---|---|
| 4— | 2500 KVA Mel. | 69000—13800 |
| 4— | 500 KVA West. | 69000—6900 |
| 2— | 400 KVA G.E. | 66000/33000—2300/4160 |
| 3— | 1250 KVA A.C. | 44000/11500—460 |
| 3— | 150 KVA Mel. | 44000—2400/7200 |
| 3— | 75 KVA West. | 44000—7200/12470 Y |
| 4— | 5000 KVA G.E. | 40935/70900 Y—14500 |
| 3— | 3333 KVA G.E. | 33000/11000—2400/7200 |
| 3— | 333 KVA G.E. | 33000—7200/12470 Y |
| 3— | 200 KVA A.C. | 33000—2400/7200/12470 |
| 3— | 75 KVA Wag. | 33000—7200/12470 Y |
| 3— | 1250 KVA G.E. | 26400/13200—2400 |
| 4— | 1500 KVA A.C. | 25400/44000—6900/13800 |
| 4— | 450 KVA A.C. | 25410/44000—13280/23000 |
| 3— | 1000 KVA Mel. | 22000—2300 |
| 3— | 500 KVA G.E. | 22000/38100 Y—240/480 |
| 3— | 100 KVA G.E. | 22000—7200/12470 Y |
| 1— | 3000 KVA Stand. | 19050/33000—4160, 3 ph. |
| 1— | 600 KVA Stand. | 13200—2300, 3 ph. |
| 1— | 450 KVA Penn. | 13200—2400, 3 ph. |
| 3— | 333 KVA West. | 13200—2400 |
| 3— | 200 KVA G.E. | 13800—2300 |
| 3— | 250 KVA Pitts. | 7200—220/440 |
| 3— | 150 KVA Wag. | 6900—2300 |
| 3— | 37½ KVA G.E. | 6900—230/460 |
| 4— | 150 KVA G.E. | 4800/2400—240/120 |
| 3— | 333 KVA G.E. | 2300—230/460 |
| 3— | 250 KVA G.E. | 2300/4000 Y—115/230 |
| 3— | 200 KVA West. | 2400—240/480 |
| 3— | 150 KVA West. | 2400—230/115 |
| 1— | 100 KVA G.E. | 2300—575, 3 ph. |
| 3— | 75 KVA A.C. | 2400—240/480 |
| 6— | 50 KVA West. | 2400—114/228 DRY TYPE |

*PARTIAL LIST ONLY*

**BREW, WOLTMAN & CO., INC.**
**50 Church St. New York 7, N. Y.**

# FLUID DRIVE · GYROL TYPE VS HYDRAULIC COUPLINGS

Stepless speed variation with constant speed prime mover made by American Blower Co. Ideal for pumping stations, steel mill drives, mechanical draft fans, crushers, rotary kilns, etc. Wide range of capacities—Condition 98% now
200 HP to 2500 HP Input
300 RPM to 900 RPM Input
Complete data & quotation on request.
Also large selection of marine couplings, reduction gears, & Falk grid type couplings in stock.

**A. G. SCHOONMAKER CO., INC.**
**50 CHURCH ST., NEW YORK 7, N. Y.**

# Check with *WAGNER FIRST!*

✓ Complete Stock A.C. & D.C. Motors and Generators
✓ New and "Certified Rebuilt"—UP to 1000 H. P.

## A. C. GENERATORS — 60 CYCLE

| KVA | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 1000 | Whse syn cond | | 4000/2300 | 900 |
| 625 | Gen. Elec. | ATB | 2300 | 450 |
| 600 | Gen. Elec. | ATB | 480 | 900 |
| 625 | El. Machy. | Late | 240/480 | 1200 |
| 485 | Allis Ch. | 1 brg. | 480 | 400 |
| 350 | El. Machy. | 1 phase | 480 | 1200 |
| 312 | Gen. Elec. | ATB | 240/480 | 600 |
| 275 | G. E. 25 cycle | ATI | 480 | 750 |
| 225 | El. Machy. | | 480 | 720 |
| 225 | Gen. Elec. | ATI | 240/480 | 900 |
| 150 | Allis Ch. | | 240/480 | 1200 |
| 150 | Gen. Elec. | ATB | 2300 | 900 |
| 150 | Whse. | | 2300/480 | 600 |
| 125 | El. Machy. | Syn. | 240/480 | 1800 |
| 125 | Gen. Elec. (2) | ATB | 240/480 | 900 |
| 112 | Gen. Elec. | ATB | 240/480 | 900 |
| 90 | Gen. Elec. | ATI | 240/480 | 1200 |
| 75 | Gen. Elec. | ATI | 240/480 | 1200 |
| 75 | El. Machy. | | 2300 | 900 |
| 56 | G. E. | ATB | 240/480 | 1200 |
| 25 | Whse. b.b. | 1 phase | 120/240 | 900 |

**LOW VOLTAGE M-G SETS—2**
Whse. 3636 amp. 20/55 V DC gen. w/synch. motor 220/440 V. 720 RPM and exciters.

## D. C. GENERATORS

| KW | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 300 | Al. Ch. | MECW | 125/250 | 1200 |
| 250 | Allis. Ch. b.b. | EW | 350 | 1200 |
| 250 | Gen. Elec. | MPC | 250 | 600 |
| 200 | Gen. Elec. | RC | 250 | 1150 |
| 150 | Gen. Elec. b.b. | CDM | 250 | 1500 |
| 105 | Century b.b. | 1500 amp. | 70 | 1200 |
| 100 | Allis. Ch. | E | 125 | 1200 |
| 75 | G. E. b.b. (2) | CDM135 | 125 | 750 |
| 75 | Whse. | SK | 250 | 900 |
| 75 | Cont. b.b. | D109X | 125 | 1200 |
| 75 | Gen. Elec. | CD115 | 250 | 1500 |
| 75 | Whse. | SK160 | 250 | 1200 |
| 60 | Whse. b.b. (2) | SK121 | 300 | 1200 |
| 60 | Whse. | SK160 | 250 | 1000 |
| 50 | Reliance | T | 250 | 1150 |
| 50 | Allis. Ch. | EW | 125/250 | 1200 |
| 40 | Gen. Elec. | CD103 | 250 | 1500 |
| 40 | F. Morse b.b. | DH | 125 | 1800 |
| 40 | Gen. Elec. | RC | 600 | 1750 |
| 25 | Whse. | SK93 | 125 | 1750 |
| 20 | Gen. Elec. | RC | 125 | 1150 |
| 15 | Star b.b. (10) | SQ | 250 | 1500 |

**ADJUSTO-SPEED MOTOR**
60 HP Louis Allis type OX-504Y b.b. 3/60/220/440 V. 400/1700 RPM with brake.

## D. C. MOTORS

| HP | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 300 | Allis Ch. b.b. | EW | 350 | 1000 |
| 250 | Gen. Elec. | LDR | 250 | 450/850 |
| 200 | G. E. (2) | RC59 | 230 | 850 |
| 150 | Whse. | SK-201 | 230 | 300/900 |
| 75 | F. Morse b.b. | DH140 | 115 | 1600 |
| 75 | Whse. | SK160 | 230 | 850 |
| 75 | Whse. | SK170 | 230 | 635 |
| 75 | G. E. | CD115 | 230 | 1150 |
| 60/75 | Gen. Elec. | C | 230 | 500/1200 |
| 50 | Reliance | 310T | 230 | 850 |
| 50 | Whse. | SK150 | 230 | 750 |
| 50 | Reliance b.b. | 651T | 230 | 750 |
| 50 | Gen. Elec. | CD123 | 230 | 550/1200 |
| 50 | Cr.Wh. b.b. | FH | 230 | 1750 |
| 50 | Whse. | SK183 | 230 | 300/900 |
| 40 | Reliance | 651T | 230 | 350/1000 |
| 40 | Allis. Ch. | E-121 | 250 | 1750 |
| 40 | Gen. Elec. (2) | CD103 | 230 | 1150 |
| 40 | Gen. Elec. | RC32 | 550 | 1200 |
| 40 | F. Morse b.b. | DH 120 | 115 | 1750 |
| 30 | Imperial b.b. | D69 | 230 | 400/1600 |
| 30 | Star b.b. (3) | SB | 230 | 1750 |
| 25 | Whse. | SK150 | 230 | 300/1200 |
| 25 | Gen. Elec. | CD85 | 230 | 1750 |
| 25 | Gen. Elec. | CD105 | 230 | 575/1720 |
| 20 | Century b.b. | DN330 | 230 | 3500 |
| 20 | G. E. series | CO-1826 | 230 | 875 |
| 20 | Whse b.b. (2) | SK97 | 550 | 900 |

**FREE!**
New WAGNER MOTOR-GRAM lists hundreds of bargains in new and rebuilt Electric Motors and Generators. Write today!

## A. C. MOTORS — 60 CYCLE

| HP | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 800 | G. E. | Slipring | 2300 | 400 |
| 750 | Whse. | Synch. | 2200/4000 | 900 |
| 700 | G. E. | Synch. | 2200 | 514 |
| 600 | G. E. | Synch. | 220/440 | 257 |
| 600 | E. M. | Synch. | 480 | 1200 |
| 600 | G. E. (2) | Synch. | 2200/440 | 360 |
| 550 | G. E. | Sq. Cage | 2200 | 3600 |
| 500 | Allis. Ch. | Slipring | 2300 | 514 |
| 500 | G. E. | Slipring | 2200/440 | 450 |
| 500 | G. E. | Sq. Cage | 6600/4000 | 1800 |
| 500 | G. E. | Synch. | 440 | 900 |
| 450 | Allis. Ch. | Synch. | 480 | 400 |
| 400 | Whse. | Sq. Cage | 2200 | 514 |
| 400 | G. E. | Synch. | 440 | 450 |
| 400 | Allis. Ch. | Sq. Cage | 2200/440 | 1200 |
| 350 | Whse. (2) | Slipring | 2300 | 450 |
| 350 | G. E. | Slipring | 2200/440 | 600 |
| 300 | El. Mach. | Synch. | 220/440 | 360 |
| 300 | Al. Ch. | Sq. Cage | 2200/440 | 720 |
| 300 | Whse. | Synch. | 2200/440 | 600 |
| 300 | Al. Ch. | Slipring | 2300 | 514 |
| 300 | G. E. | Slipring | 440 | 360 |
| 250 | G. E. | Synch. | 220/440 | 720 |
| 250 | Whse. (2) | Sq. Cage | 2200/440 | 1200 |
| 250 | I. A. (2) | Sq. Cage | 2200 | 1800 |
| 225 | G. E. | Synch. | 220/440 | 900 |
| 200 | Whse. Ex. Pf. | Sq. Cage | 2200/440 | 1200 |
| 200 | Allis. Ch. | Slipring | 440 | 450 |
| 200 | Gen. Elec. | Sq. Cage | 2200/440 | 720 |
| 200 | Cr. Wh. | Sq. Cage | 220/440 | 3600 |
| 200 | Whse. | Sq. Cage | 2200/440 | 900 |
| 200 | G. E. | Slipring | 220/440 | 600 |
| 200 | E. M. | Synch. | 220/440 | 1200 |
| 200 | G. E. | Slipring | 220/440 | 360 |
| 200 | Whse. | Sq. Cage | 220/440 | 1800 |
| 200 | G. E. | Sq. Cage | 220/440 | 1200 |
| 200 | E. M. | Synch. | 220/440 | 514 |
| 175 | Whse. | Synch. | 220/440 | 360 |
| 150 | Whse. | Sq. Cage | 220/440 | 900 |
| 150 | G. E. TEFC | Sq. Cage | 2200 | 3600 |
| 150 | Allis Ch. | Slipring | 2200/440 | 720 |
| 150 | G. E. | Synch. | 220/440 | 450 |
| 150 | Allis Ch. | Slipring | 2200/440 | 720 |
| 150 | G. E. (2) | Sq. Cage | 2200/440 | 720 |
| 150 | G. E. | Slipring | 220/440 | 450 |
| 150 | Allis Ch. | Sq. Cage | 2200/440 | 1200 |
| 150 | Rel. b.b. | Sq. Cage | 220/440 | 1800 |
| 150 | Allis Ch. | Sq. Cage | 440 | 450 |
| 125 | Rel. TEFC | Sq. Cage | 220/440 | 1800 |
| 125 | G. E. (2) | Slipring | 220/440 | 600 |
| 125 | G. E. | Slipring | 220/440 | 450 |
| 125 | E. M. (2) | Synch. | 220/440 | 1800 |
| 125 | G. E. | Slipring | 2200/440 | 720 |

## MOTOR-GENERATOR SETS

| KW | Mfr. | Input V | Output V |
|---|---|---|---|
| 500 | Whse.* | 2300 AC | 250 DC |
| 300 | G. E.* | 440 AC | 250 DC |
| 300 | Allis. Ch. | 2200/440 AC | 125/250 DC |
| 300 | Whse.* | 2300 AC | 600 DC |
| 250 | Allis. Ch. | 2200/440 AC | 350 DC |
| 200 | Whse.* (2) | 220/440 AC | 55 DC |
| 200 | G. E.* | 220/440 AC | 250 DC |
| 200 | Gen. Elec.* | 220/440 AC | 125 DC |
| 175 | G. E. | 2200/440 AC | 250 DC |
| 105 | Century b.b. | 220/440 AC | 70 DC |
| 100 | Al. Ch. | 220/440 AC | 125 DC |
| 100 | Deleo b.b. | 220/440 AC | 125/250 DC |
| 90 | G. E.* (2) | 220/440 AC | 125 DC |
| 80 | Star* b.b. | 220/440 AC | 240 DC |
| 75 | Cont. b.b. | 220/440 AC | 125 DC |
| 75 | G. E. (2) | 220/440 AC | 250 DC |
| 60 | Gen. Elec.* | 220/440 AC | 60 DC |
| 60 | Whse. (2) | 220/440 AC | 360 DC |
| 50 | Gen. Elec. | 220/440 AC | 125 DC |
| 50 | Allis Ch. | 220/440 AC | 125/250 DC |
| 50 | Cr.Wh.b.b.(2) | 220/440 AC | 240 DC |
| 40 | G. E. (2) | 220/440 AC | 250 DC |
| 40 | Gen. Elec. | 220/440 AC | 600 DC |
| 30 | Whse. | 220/440 AC | 250 DC |
| 25 | Whse. | 220/440 AC | 125 DC |
| 25 | Gen. Elec. | 220/440 AC | 250 DC |
| 20 | Star b.b. | 220/440 AC | 120 DC |
| 15 | El. Prod. | 220/440 AC | 40 DC |

*Synch. motor.

**THESE ARE PARTIAL LISTINGS . . . 10,000 OTHER UNITS IN STOCK**

**OUR 48th YEAR**
***Serving American Industry***

**ARTHUR WAGNER COMPANY**
1435 W. RANDOLPH ST. • CHICAGO 7, ILLINOIS
**TELEPHONE MOnroe 6-7409**

# GUARANTEED REBUILT POWER EQUIPMENT

## M. G. SETS

| KW | Make | AC | DC |
|---|---|---|---|
| 2400 | West. (3-u.) | 4800 | 525 |
| 1000 | West. (3-u.) | 11000 | 137/275 |
| 500 | AC-West. | 2300 | 250 |
| 450 | G. E. (3-u.) | 2300 | 125/250 |
| 400 | A. C. | 2300 | 120/240 |
| 300 | Cr-Wh | 440 | 250 |
| 200 | G. E. | 440 | 550 |
| 200 | West. | 2300 | 275 |
| 200 | G. E. | 440 | 600 |
| 150 | G. E. | 2300/440 | 250 |
| 150 | G. E. | 2300/4000 | 125/250 |
| 150 | G. E. | 440 | 275 |
| 125 | G. E. | 440 | 300 |
| 125 | West. | 440 | 250 |
| 100 | G. E. (25 cy.) | 440 | 125 |
| 100 | G. E. | 2300 | 250 |
| 100 | Ridgway | 2200 | 275 |
| 100 | West. | 220 | 125 |
| 100 | Elec. Machy | 220 | 125 |
| 90 | G. E. | 220 | 250 |
| 90 | G.E. | 440 | 60 |
| 75 | Reliance | 2300/440 | 250 |
| 75 | G. E. | 440 | 125 |
| 60 | A. C. | 2300 | 110 |
| 50 | G. E. | 440 | 250 |
| 40 | A. C. | 220 | 125 |
| 35 | West. | 2200 | 125 |
| 30 | G. E. | 220/440 | 250 |
| 25 | Cr-Wh | 440 | 125 |
| 20 | G. E. | 440 | 250 |
| 20 | Bogue-GE | 550 | 250 |
| 20 | Bogue-GE | 220/440 | 125 |

## TRANSFORMERS

| KVA | Make | Phase | Pri-mary | Second-ary |
|---|---|---|---|---|
| 1000 | West. | 3 | 4800 | 480 |
| 850 | West. | 3 | 34160 | 455 |
| 667 | G.E.(H) 1 | 3 | 34500 | 480 |
| 667 | G. E. | 1 | 3000 | 480 |
| 500 | American | 1 | 2400 | 240/480 |
| 400 | G.E.(H) | 1 | 2300 | 230/440 |
| 400 | West. (air) | 3 | 12000 | 213 |
| 300 | G. E. | 3 | 13800 | 240/480 |
| 300 | G. E. | 3 | 2400 | 240/480 |
| 250 | G. E. | 1 | 4160 | 240/480 |
| 200 | Wagner | 1 | 2400 | 575 |
| 167 | A.C. | 1 | 2400 | 120/240 |
| 100 | Pittsburgh | 1 | 2400 | 575 |
| 100 | Pittsburgh | 1 | 2400 | 240/480 |
| 100 | American | 1 | 2400 | 240/480 |
| 100 | G. E. (Py'l) | 1 | 2400 | 120/240 |
| 50 | Westgh. (CSP) | 1 | 7200 | 120/240 |
| 50 | West. | 1 | 2400 | 120/240 |

## TRANSFORMERS

Dry Type Air Cooled
STANDARD or SPECIAL RATINGS
Made to your Specifications
Any Quantity Quick Deliveries
Send us your Inquiries for Prompt Quotations

SLIP RING

## MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

| HP | Make | Type | Speed |
|---|---|---|---|
| 2000 | *G. E. | MT-12 | 600 |
| 2000 | *G. E. | MT-30 | 287 |
| 1500 | *G.E. | MT-30 | 240 |
| 1250 | *West. | CW | 600 |
| 1000 | *West. | CW | 250 |
| 700 | *A. C. | ANY | 720 |
| 500 | *G. E. | IM | 3600 |
| 500 | *G. E. | MTP | 1800 |
| 500 | *G. E. | MT | 450 |
| 500 | West. | CW | 350 |
| 400 | A. C. | 3-brg. | 450 |
| 400 | *G. E. | MT412 | 450 |
| 350 | West. | CW | 900 |
| 300 | *G. E. | IM13A | 1800 |
| 300 | *G. E. | MT410 | 450 |
| 250 | West. | HF15H | 600 |
| 200 | G. E. | IM15 | 1200 |
| 150 | G. E. | MT549 BB | 1800 |
| 125 | *G. E. | MT549 | 1800 |
| 125 | G. E. | IM15A | 600 |
| 100 | A. C. | ANY | 900 |
| 100 | G. E. | IM13A | 1800 |
| 100 | G. E. | IM15A | 450 |
| 75 | Northw'n | HW50 | 1800 |
| 75 | G. E. | MT347 | 1200 |
| 75 | G. E. | MT356 | 900 |
| 75 | G. E. | IM | 720 |
| 75 | G. E. | IM14 | 600 |
| 60 | West. | CW762C | 900 |
| 50 | G.E. | IM11A | 1800 |

SQUIRREL CAGE

## MOTORS

3 Phase, 60 Cycle, 220 or 440 Volts (*2200 volts or higher)

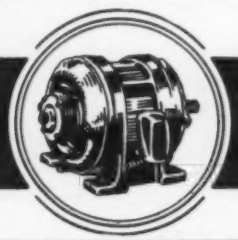
| HP | Make | Type | Speed |
|---|---|---|---|
| 1750 | *G. E. | K | 3600 |
| 1000 | *G. E. | K6347S | 1800 |
| 750 | *A. C. | TEFC | 1800 |
| 750 | *G. E. | KT | 720 |
| 700 | G. E. | FT | 3600 |
| 500 | *A. C. | 6316SW | 1800 |
| 400 | *G. E. | KF559 | 3600 |
| 300 | *West. | CS | 3600 |
| 250 | *L. Allis | OGX148 | 720 |
| 250 | G.E. | IK | 600 |
| 200 | *G. E. | FT549Y | 3600 |
| 200 | A. C. | ARW | 3600 |

## AIR COMPRESSORS

| Size | Make | Type | PSI | Displs |
|---|---|---|---|---|
| 10x11 | Worth. | HB | 100 | 294 |
| 11x12 | Worth. | HB | 100 | 426 |
| 12x13 | Worth. | HB | 125 | 460 |
| 20x12 by 14 | Sullivan | WN4 | 100 | 2032 |

If you don't find what you need. Write, write or phone for complete stock list.

## PHONE: CANAL 6-2900



# CHICAGO Electric Co.

1320 WEST CERMAK ROAD, CHICAGO 8, ILL.

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FOR QUICK, DEPENDABLE

# COMPRESSOR
## VACUUM PUMP
## SERVICE

AMERICAN AIR of JERSEY

GAS • DIESEL • STEAM • ELECTRIC

*SELL—BUY—TRADE—RENT—REPAIR*

A RENTAL COMPRESSOR FOR EVERY JOB

55 CFM Lindsay (GAS) Portable
60 CFM Worthington (GAS) Portable
70 CFM Smith (GAS) Portable
89 CFM 6 x 7 Worthington HB, 15 HP Elec
105 CFM Worth-IR-CPT Portable
107 CFM 7-7 x 7 Ingersoll FS-1 STEAM
129 CFM 7½ x 7 American AF-1, 20 HP
142 CFM Ingersoll Semi-Portable 25 HP
160 CFM IR-Worth Portable
165 CFM Smith 110SR Semi-Portable, 25 HP
195 CFM 8-9 x 9 Worthington HS STEAM
210 CFM Worthington (GAS or DIESEL) Port
211 CFM 9 x 9 Worthington HB, 40 HP Elec
279 CFM 11-10 x 11 Worthington HS STEAM
294 CFM 10 x 12 Worthington HB, 50 HP
315 CFM Worthington (GAS or DIESEL) Port
387 CFM Gardner Semi-Portable, 75 HP
445 CFM Gardner Semi-Portable, 100 HP
462 CFM 12-14½ x 13 American AF-S STEAM
500 CFM Worthington (DIESEL) Portable
538 CFM Worthington Semi-Portable, 100 HP
600 CFM Worthington (DIESEL) Portable
628 CFM 14 x 13 Ingersoll ES-1, 100 HP

MANY OTHERS TO CHOOSE FROM
GUARANTEED PERFORMANCE
*COMPRESSORS SINCE 1902*

*American*
AIR COMPRESSOR CORP.
DELL AVE. & 47th ST.
NORTH BERGEN, N.J.
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## A FEW SPECIALS

### BOILERS

1000 H.P. Combustion, 4 Drum, 200#
812 H.P. (2) Combustion, 4 Drum, 300#
600 H.P. B&W 4 Drum 200#
548 H.P. (2) Keeler "CP" "1948" 450#
500 H.P. (2) BW straight tube 200#
400 H.P. BW 3 Drum, 160# "1949"
300 H.P. BW 200# Sec. HDR
256 H.P. Combustion, "1949" 150#
250 H.P. BW 3 Drum, 225# "1948"
205 H.P. Scotch, 175#, Oil
197 H.P. Kewanee "1948" 125#
180 H.P. Cleaver Brooks, 150# (Package)

### TURBO UNITS, non-condensing

937 KVA GE 480/240 v.; O/15# bp
625 KVA Al.Chal.-Elliott 480/240 v.; O/15# bp
375 KVA Al.Chal.-Elliott 240/480 v.; O/25# bp
125 KVA GE 240/480 v.; O/30 bp Turbine: 568 HP. Murray (new)

### STEAM ENGINE UNITS (Uniflow)

375 KVA (2) Wghse.-Skinner, 3/60/600 v.
312 KVA GE-Skinner 240/480 v.
250 KVA (2) GE-Skinner, 240/480 v.
210 KVA (2) GE-Ames, 240/480 v.
187 KVA Wghse.-Ames vertical, 240/480 v.

### DIESEL UNITS (Modern)

1136 KVA (4) FM, opposed piston, 720 rpm
590 KVA FM 33E14, 300 RPM
490 KVA FM 33E14: 300 RPM
300 KVA Fairbanks Morse 277 rpm
250 KVA FM, 33E14; 300 RPM
220 KVA (2) Wghse-Buckeye "E" 400 rpm
187 KVA Ideal-Buckeye "E" 400 rpm
185 KVA FM, 32E14; 300 RPM
125 KVA GE-Hercules, 1800 RPM

**POWER PLANT EQUIPMENT CO., INC.** 39 Cortlandt St. New York, N. Y.

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BUSINESS PERSONNEL SELLING
EQUIPMENT FINANCIAL

# OPPORTUNITIES

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# SPECIAL OFFER TO: CHEMICAL REFINERIES

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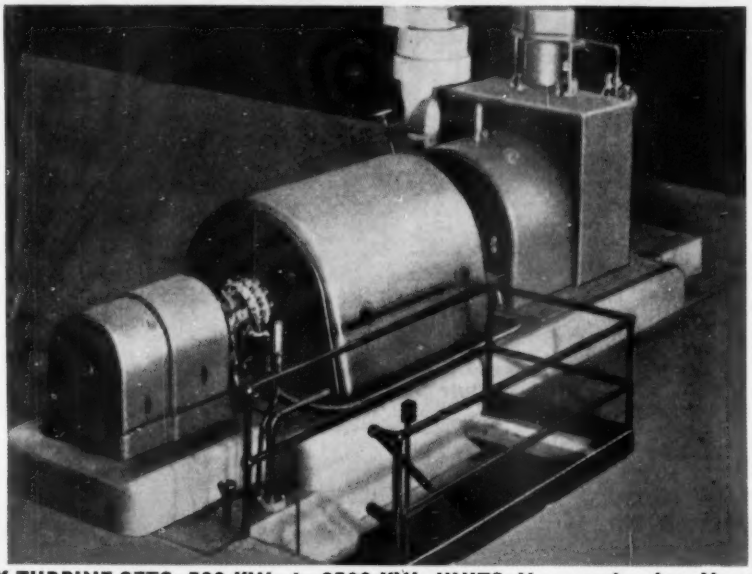

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**REFINERY TURBINE SETS: 500-KW., to 2500-KW., UNITS, Non-condensing, Now in Stock: Immediate Deliveries.**

**ALSO 2 B & W BOILERS, New, Never Erected, 150,000 lbs. pr. hr. 350# psig., 750°F. TT., 2-Drums. Many Other High-Grade Boilers.**

ALL PRICED FOR QUICK SALES. SEND US MEMO. OF ANYTHING NEEDED FOR YOUR POWER PLANT

IN STOCK ALSO: CONDENSING TURBINE SETS 300-KW. to 12,000-KW., ALL HIGH GRADE UNITS: ALSO FULL LINE OF DIESEL POWER

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4145 PENOBSCOT BUILDING
DETROIT 26, MICHIGAN

TELEPHONE: WO. 1-1340-1



## MOTORS · MG SETS

*All guaranteed for one year.*

| Qty. | HP | Make | Voltage | S peed |
|---|---|---|---|---|
| 26 | 1500 | West. | 525/600 | 600 RPM |
| 32 | 1500 | Al. Ch. | 525/600 | 675 RPM |
| 4 | 1200 | Al. Ch. | 525/600 | 650 RPM |
| 2 | 900 | Elliott | 230 | 300/195 RPM |
| 3 | 800 | West. | 525/600 | 600/900 RPM |
| 1 | 650 | Cr. Wh. | 230 | 475/720 RPM |
| 1 | 500 | West. | 230 | 250/500 RPM |
| 1 | 400 | G.E. | 230 | 480/860 RPM |
| 12 | 3000 | West. | 525/600 | 600 RPM |
| 7 | 400 | Elliott (new) | 230 | 400/800 RPM |
| 5 | 400 | West. (new) | 230 | 375/750 RPM |
| 2 | 350 | Cr. Wh. | 230 | 400/800 RPM |
| 1 | 200 | Cr. Wh. | 230 | 500/750 RPM |
| 1 | 200 | Cr. Wh. | 230 | 375/750 RPM |

All motors designed for mill reversing service.

Smaler sizes also in stock.

**Motor Generator Sets in Stock**
**100—2000 KW Capacity**

All of above is modern late type equipment remanufacturel & tested by our engineers.

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50 CHURCH ST. NEW YORK 7, N. Y.

Plants: SAUSALITO (S.F.) CALIF., JERSEY CITY, N. J.



## M-G SETS! MOTORS!

1—500 KW, 240 V. D.C., Whse. M-G Set, 900 RPM, Syn. Drive, 3/60/2200, Ser. 4979926 with magnetic reduced voltage starter.

1—200 KW, 125 V. D.C., Type PED, Ser. 576881, E-M Set, 900 RPM. Syn. drive, 3/60/2300 (or 4160).

**TURBO-GENERATOR**

1—750 KW, Elliott AC Generator, Frame 3232, 3600 RPM, 3/60/480. Elliott Turbine, inlet 200# ga., 112 deg. F superheat, 28" hg. vac. exhaust. Complete with accessories.

**SQUIRREL CAGE MOTORS**

| Amt. | HP. | Speed | Make | Type | Frame |
|---|---|---|---|---|---|
| 1 | 250 | 1200 | Elliott—BB | Splash | 2810 |
| 3 | 250 | 600 | G. E. | KT568 | |
| 1 | 150 | 1800 | A-C | | |
| 1 | 150 | 900 | G. E. | I-K (2200V.) | |
| 1 | 100 | 1800 | Whse. | CS | 663C |
| 1 | 100 | 1200 | L.A. XP-1D | EX | 108 |
| 1 | 100 | 900 | G. E. | MT356 | Slpr. |

**NEW MOTOR STARTERS**

1—Size 4, A-C magnetic starter, 3/60/440

6—Size 3, A-B, XP-2G Label Bul. 709

1—Size 3, Whse. Combination, circuit breaker, Nema 1, 3/60/440

21—Size 2, G.E. Combination fusible, 60 and 100 amp, 3/60/220

88—Size 1 Whse. life line, 3/60/220

1—250 HP, G.E. manual compensator, 3/60/440 CR1034-K33

1—250 HP, G.E magnetic compensator, 3/60/440 CR7051D2G

6—60 thru 200 HP EC&M, 3/60/2300 Size 10 Magnetic Compensators

**GEARMOTORS**

1—20 HP, 400 RPM, Westinghouse ID-XP

1—15 HP, 100 RPM, G.E. tri-clad, Fr. 365

3—10 HP, 55 RPM, Whse. Fr. 324, parallel shaft output

1—7½ HP, 11 RPM, Whse. Fr. 284Y, TEFC

17—Cleveland right angle worm gear reducers, rated 5 HP-1150 RPM, 7.5 HP-1750 RPM, 6-1 ratio, Series 215, Size 50 RT, Class 1

4—Ratio 10-1, Series 25F—ditto

**NEW INGERSOLL-RAND MOTOR PUMPS**

| Amt. | GPM. | HD. | Type | Motor Encl. |
|---|---|---|---|---|
| 2 | 140 | 90 | 2-ORVL-7½ | TEFC |
| 2 | 134 | 90 | 2-ORVH-5 | XP-1-D |
| 1 | 1500 | 35 | 5-KVL-25 | XP-1-D |

**OISC-TRANSFORMERS—Single Phase**

| Amt. | KVA. | Make | Type | Volts |
|---|---|---|---|---|
| 9 | 37½ | G.E., Moloney, Whse. | | 2400-240/480 |
| 2 | 50 | Wagner | HEX | 4000-1328/2300Y |
| 3 | 75 | Whse. | S | 2400/4160-480/240 |
| 3 | 150 | Moloney | HE | 4000-230/460 |

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**BENSON-WILIMZIG, INC.**

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**FOR SALE**

1—100,000# Worthington Deaerating Feedwater Heater, Unused.

**SUNDFELT EQUIP. CO., INC.**
**220 Hudson Seattle 4, Wash.**

## SLIP RING MOTORS 3-Ph., 60 Cy.

| H.P. | Volts | Make | Speed |
|---|---|---|---|
| 600 | 440 | Whse. | 1800 |
| 600 | 2200 | Whse. | 450 |
| 500 | 2200/4000 | G. E. | 900 |
| 450 | 440 | Whse. | 514 |
| 450 | 440 | Whse. | 720 |
| 400 | 440 | G. E. | 900 |
| 300 | 4000/2300 | Whse. (new) | 600 |
| 300 | 2200/440 | G. E. | 720 |
| 300 | 440 | G. E. (hoist) | 600 |
| 300 | 2200 | G. E. | 360 |
| 300 | 440 | Whse. | 3600 |
| 250 | 440/220 | Whse. | 600 |
| 250 | 550/440 | G. E. | 1200 |
| 250 | 440 | G. E. | 600 |
| 200 | 440/220 | Whse. | 514 |
| 200 | 440 | G. E. | 450 |
| 150 (2) | 440/220 | G. E. | 720 |
| 150 | 2200/440 | G. E. | 600 |
| 150 | 550/220 | G. E. | 720 |
| 145 | 4000/2300 | G. E. | 1800 |
| 135 | 440/220 | G. E. (hoist) | 600 |
| 125 | 440/220 | G. E. | 900 |
| 125 | 550/440 | G. E. | 1200 |
| 125 | 2200 | G. E. | 600 |

## SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

| H.P. | Volts | Make | Type | R.P.M. |
|---|---|---|---|---|
| 400 | 2200/440 | G. E. | ATI | 720 |
| 375 | 440/220 | Whse. | G | 900 |
| 350 | 440/220 | El. Mchy. | Syn. | 1200 |
| 300 | 2300/400 | G. E. | TS | 720 |
| 300 | 2200/440 | G. E. | TS | 1200 |
| 250 | 2200/440 | G. E. | TS | 720 |
| 250 | 440/220 | G. E. | ATI | 1200 |
| 250 | 2300 | G. E. | TS | 3600 |
| 250 | 440/220 | Whse. | HR | 277 |
| 250 | 2200/440 | G. E. | TS | 1200 |
| 250 | 440/220 | G. E. | ATI | 600 |
| 200 | 4150/2300 | Whse. | G | 1800 |
| 125 | 440/220 | Whse. | HR | 400 |
| 110 | 440/220 | G. E. | TS | 257 |

## SQUIRREL CAGE MOTORS

| H.P. | Volts | Make | Type | Speed |
|---|---|---|---|---|
| 600 | 2200 | G. E. | FT | 3600 |
| 500 | 2200 | Whse. | CS | 514 |
| 500 | 2200/4000 | Elliot | SC | 1800 |
| 500 | 2200 | G. E. | | 450 |
| 400 | 2200 | G. E. | | 360 |
| 400 | 2200/400 | Whse. | CS | 720 |
| 300 | 2200 | L. Allis | FS | 1800 |
| 250 | 2200/440 | G. E. | IK | 720 |
| 225 (2) | 2200/440 | G. E. | KT | 1200 |
| 200 | 2200/440 | G. E. | K | 1200 |
| 200 | 440 | G. E. | IK | 720 |
| 200 | 440/220 | G. E. | KT | 1800 |
| 200 | 2200/440 | G. E. | JK | 600 |
| 200 | 2200 | G. E. | KT | 1800 |
| 150 | 440/220 | Whse. | CS | 900 |
| 150 | 2200 | Al. Chal. | AR | 1800 |
| 150 | 220 | Whse. | CS | 1200 |
| 150 | 440 | Multi sp. | KT | 1800/600 |
| 150 | 440/220 | G. E. | IK | 450 |
| 150 | 440/220 | G. E. | KT | 720 |
| 150 | 440/2200 | G. E. | IK | 514 |
| 150 | 2200/440 | G. E. | KT | 600 |
| 125 | 440/220 | G. E. | KT (vert.) | 1200 |
| 100 | 2200/440 | G. E. | FK | 1200 |
| 100 | 220/440 | G. E. | K-TEFC | 720 |
| 60 (2) | 2200 | Whse. | CS X-pf. | 1800 |
| 50 (2) | 410/220 | Whse. | CS-TEFC | 1800 |
| 50 | 220 | Al. Chal. | X-prf. | 600/1200 |

## A. C. GENERATORS

1—320 kva. 660 rpm 2300/440/220 V., G.E.
1—300 kva. 900 rpm. 480/220 V., G. E.
1—250—kva. 720 rpm. 2300/440 V., G. E.
1—225 kva. 600 rpm. 220/440 V. G. E.
1—200 kva. 720 rpm. 2200/440 V., G. E. (Ball brg.)
1—187 kva. 1200 rpm. 2200/440 V., Whse.

## CIRCUIT BREAKERS

2—2000 amp. GC E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-155-28, 600 amp., 15,000 V., G.E., Sol. oper., draw-out

## D. C. MOTORS

| H.P. | Volts | Make | Type | Speed |
|---|---|---|---|---|
| 250 | 230 (2 new) | Cr. Wh. | CMC | 1800 |
| 225 | 230 | Whse. | SK | 2870 |
| 200 | 230 | G. E. | CD | 750 |
| 150 | 230 | Whse. | SK | 1750 |
| 100 | 230 | Whse. | SK | 400/1200 |
| 100 | 230 | Cr. Wh. | CMC | 625 |
| 90 | 230 | G. E. | CD | 1750 |
| 80 | 230 | G. E. | RC | 600 |
| 50 | 230 | Rel. | T | 400/1200 |

## MOTOR GENERATOR SETS

| KW | Make | Input V., AC | Motor Type | Output V., DC |
|---|---|---|---|---|
| 250 | Whse. | 440/220 | Syn. | 250 |
| 250 | Whse. | 2200 | Syn. | 250 |
| 175 | G. E. | 220/440 | Syn. | 230 |
| 125 | G. E. | 440/220 | Syn. | 250/125 |
| 100 | Al. Ch. | 220/440 | sq. ca. | 240/120 |
| 100 | Whse. | 440/220 | sq. ca. | 125 |
| 75 | G. E. | 2200/440 | Syn. | 125 |
| 65 | G. E. | 2200/440 | sq. ca. | 250 |
| 65 | G. E. | 2200/440 | sq. ca. | 125 |
| 45 | G. E. | 440/220 | sq. ca. | 250 |

## TRANSFORMERS 60 Cy.

3—667 kva. Al. Chal., 22000/11000—2300 V.
1—600 kva. Standard, 13,800-2300 V. 3 ph.
3—500 kva. G. E. 22000/11000—2300 V.
3—500 kva. Whse., 66000—2300 V.
3—333 kva. G. E., 12000—2300 V.
3—200 kva. G. E. 2300—575 V.
3—200 kva. G. E., 11000—2300 V.
3—200 kva. G. E., 4150—480/240 V.
3—150 kva. G. E., 33000—2300/4600 V.
3—150 kva. Al. Chal., 2400—240/480 V.
3—150 kva. Al. Chal., 2400—240/120 V.
6—100 kva. Whse., 2400—120/240 V.
5—100 kva. G. E., 4150—120/240 V.
2—100 kva. Whse., 2400—120/55 V.
3— 75 kva. Whse., 2400—240/480 V.
3— 75 kva. Moloney, 4150—240 V.
3— 50 kva. Whse., 440—220/110V
6—50 kva. G. E., 2400—120/240V

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1250 KVA Westg., 3 ph., 60 cy., 480 volts, 1200 RPM, with 15 KW direct connected Excitor. Late modern steel frame & base unit. Complete with control gear.

### 125 VOLT DC GENERATORS

| KW | Make | Speed |
|---|---|---|
| 200 | West. | 900 |
| 150 | Westg. | 1200 |
| 150 | Westg. (3) | 900 |
| 100 | Cr. Wh. | 1200 |
| 100 | E.M. | 1200 |
| 100 | G. E. (2) | 900 |
| 100 | Westg. | 1200 |
| 100 | Westg. (2) | 900 |
| 75 | G. E. (2) | 1200 |
| 50 | Westg. (2) | 1150 |

PLUS 40 additional units ½ to 40 KW

### 250 VOLT DC GENERATORS

| KW | Make | Speed |
|---|---|---|
| 2000 | G. E. | NEW |
| 1150 | G. E. | NEW |
| 750 | G. E. (2) | NEW |
| 400 | G. E. | NEW |
| 250 | Cr. Wh. | 1200 |
| 200 | El. Mchy. | 900 |
| 150 | G. E. | 1200 |
| 135 | G. E. (2) | 1200 |
| 125 | E. D. | 1750 |
| 100 | Deleo (4) | 1150 |
| 75 | Westg. | 900 |
| 75 | Cr. Wh. | 1150 |
| 60 | N. W. | 1150 |
| 40 | Rel. | 1750 |
| 40 | G. E. 3-Unit | 1150 |
| 25 | G. E. | 1200 |
| 17 | A-C | 1750 |
| 15 | Star | 1750 |
| 10 | G. E. | 1150 |

PLUS 15 additional units ½ to 7½ KW

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1—2000 GPM 350' Pump with 240 HP Turbine
1—1100 GPM 220' Allis-Ch. Cent. Pump
1—1000 GPM 280' all-bronze Cent. Pump
1—750 GPM 231' Pump with 75 HP 3 ph. Motor
2—600 GPM 360' Pump with 72 HP Turbines
1—200 GPM 556' Pump with 50 HP Turbine
1—Kinney unused 6" Rotary Pump, 450 GPM
3—Blackmer 6" Rotary Pumps, 500 GPM
3—750 & 1000 GPM Knowles Steam Fire Pumps
1—8"x10" & 1—7"x8" Triplex Pumps
1—3"x8" Galland Hydraulic Triplex Pump
1—12"x14" Duplex Air Compressor, 850 CFM
1—12"x10" 1-R Air Compressor, 355 CFM
2—12"x9" Worth. Comp. 375 CFM Vac. & Press.
1—4-stage Norwalk Compressor 28 CFM 5000 PSI
1—GE Turbo-Blower 8500 CFM 16 oz., 58 H.P.
1—Sturtev. Turbo-Blower 7000 CFM 20 oz., 60 HP
4—Roots Blowers, No. 710AF, 400 CFM 5 PSI
1—Nash Vacuum Pump, #4, 450 CFM
2—Allen-B. Turbo Blowers 500 CFM—5 PSI
1—Kinney Vacuum Pump No. 12-8-14, 217 CFM
1—Beach-Russ No. 8 Vacuum Pump, 175 CFM
1—GE 2-stage Turbo-Blower 3000 CFM 16 PSI
2—Buffalo No. 7E Blowers 5000 CFM—20 oz.
12—Nash Vacuum Pumps & Vac-Heating Units
1—DeLaval Steam Turbine, 125 H.P., 1750 RPM

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ALL MAKES

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complete with controls, etc.

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100 HP Westinghouse 3-60-2200-1200
75 HP General Electric 3-60-440-1800

**SQUIRREL CAGE MOTORS**

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100 HP Elec. Mchy. 3-60-440-1200

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2—1500 KW Westinghouse 275 V D.C. 514 rpm with 3/60/13,200 V. Synch. Mtr. drive.
1—100 KW West SK Comp'd 125 V., 150 HP West syn. 3/60/440/1200 rpm.
1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
2—250 KW Burke 125 V. 435 KVA Syn. M.D. 3/60—any voltage
1—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
100 KW Electro Dynamic 200 V. 3/60/220/1200 B. Brg. Sq. Cg. Sep. Excited.
1—100 KW Al. Ch. 250 V. 1200 RPM 150 HP. Syn. Mtr. 2/60 or 3/60 any voltage.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph, any voltage.
1—62½ KW 125 volt Hertner, 1200 rpm, 100 HP Sq. Cg. 3/60/220
2—50 KW GE 500 Volt DC, 75 HP, 3/60/40/1200 RPM.
Smaller Sizes and Types—Advise Requirements

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1—300 HP Keeler CP 300 lb. Oil
1—250 HP Ames Package type (1948) 150 psi oil fired
1—250 HP B & W 250 lb. 1948
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1—100 HP Clayton Pkg type 160 psi oil fired
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3—920 KW Alco Diesel Generators 3/60/2400/4160Y—(New) 720 rpm with all accessories
1—375 KVA GM 8-268A, 3/60/480/1200 RPM
1—187 KVA G.M. Twin 6-71 Portable, 3/60/220/440 New
2— 45 KVA Chry. New 6 Cyl. 3/60/220/440.
1—18.75 KVA Hercules Diesel with U. S. Generator 1/60/120-240 and panel

## ELECTRIC MOTORS

| Qu. | HP | Make | Type | Volts | Speed |
|---|---|---|---|---|---|
| 1 | 1500 | Al. Ch. | sl. rg. | 2300 | 514 |
| 1 | 1000 | G.E. | K | 2300 | 1800 |
| 1 | 1000 | West. | CW | 2300 | 450 |
| 1 | 700 | West. | CS | 2300 | 1800 |
| 1 | 500 | Al. Ch. | Syn. | 2300 | 212 |
| 1 | 500 | AC | ARX | 2300 | 1800 |
| 1 | 500 | West. | CS | 6600/2300 | 514 |
| 1 | 450 | A.C. | ANY | 2300 | 600 |
| 1 | 400 | West. | CW | 440 | 514 |
| 1 | 400 | G.E. | Syn. | 2300 | 450 |
| 3 | 3500 | G.E. | IM | 2300 | 120 |
| 1 | 350 | G.E. | MT18 | 2300 | 400 |
| 2 | 200 | G.E. | KT559 | 2200 | 1200 |
| 1 | 200 | West. | CW | 440 | 1800 |
| 1 | 200 | G.E. | IM | 440 | 600 |
| 1 | 125 | West. | Syn. 3 brg. | 550 | 600 |
| 2 | 100 | G.E. | KT352 | 220/440 | 1200 |
| 1 | 50 | West. | CS | 440 | 3600 |
| 1 | 50 | West. | CS | 440 | 1200 |

## TURBO GENERATORS
### Philadelphia Stock

1—2500 KVA West. Cond. New 1936. 3/60/2400—200 psi Surf. Cond.
1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—938 KVA GE-Terry Aut. Extr. 3/60/480 150 psi. 20 lb. B.P. Surf. Condenser 1934
1—780 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 psi 5 lb. B.P.
1—50 KVA 1200 rpm Century generator (New 1949) Dean Hill Non-condensing turbine
1—75 KW G.E. Non-Cond. D.C. 125 volt.

## AIR COMPRESSORS

1—1600 CFM Sullivan WJ 8 Angle Cpd. 100 psi 22/13x16 belt.
1—1000 CFM Chicago OCE Syn. Mtr. Dr. 175 HP 3/60/2300.
1—978 CFM Sullivan 13x13x8, 45 psi.
1—670 CFM Chicago OCE Syn Mtr Dr. 3/60/2300
1—396 CFM Sullivan WL60 125 psi Direct Drive 75 HP 3/60/440
1—215 CFM Penna 3A, 70 psi—V-Belt.
1—368 CFM Chi. NSB, 12x10, 100 psi.
1—371 CFM Schramm 7⅛x5x4, 100 psi
1—173 CFM Chicago NSB 100 psi

## OISC TRANSFORMERS

| Qu. | KVA | Make | Pri. V. | Sec. V. | Phase |
|---|---|---|---|---|---|
| 3 | 2000 | G.E. | 13200 | 230/460 | 1 |
| 3 | 1000 | GE | 13200 | 2300 | 1 |
| 1 | 1100 | West. | 4160 | 440 | 3 |
| 3 | 667 | Al. Ch. | 33000 | 2300 | 1 |
| 3 | 500 | West. Dry | 33000 | 2300 | 1 |
| 3 | 500 | West. | 22000 | 460 | 1 |
| 1 | 500 | Gregory | 4160 | 440 | 3 |
| 3 | 500 | GE | 13200 | 2300 | 1 |
| 3 | 400 | GE | 2400 | 480 | 1 |
| 3 | 333 | West. Dry | 2400 | 480 | 1 |
| 3 | 333 | Pitts. | 33000 | 2300 | 1 |
| 3 | 333 | G.E. | 13800 | 240/480 | 1 |
| 2 | 250 | West. Dry | 13800 | 230 | 1 |
| 3 | 150 | West. | 2300 | 230/115 | 1 |
| 3 | 150 | Dry | 2300/4160 | 230/460 | 1 |
| 3 | 100 | Dry | 2300/4160 | 230/460 | 1 |

1—New O'Brien "Red-Line" 750 KVA OISC Transformer 13,200/13,800 v. pri., 480 v., sec., 3 ph.
3—333 KVA New O'Brien Red Line O.I.S.C. Transformers 4160 V primary 480 V secondary ea. single ph. 60 cyc.

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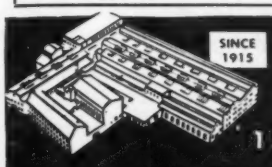

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| Qu. | H.P. | Make | Type | Description |
|---|---|---|---|---|
| 3 | 25 | Ideal | A-365 | S. B. open |
| 3 | 40 | L. A. | OGX-404 | S. B. drip proof |
| 3 | 50 | Century | SC-405 | S. B. drip proof |
| 2 | 50 | Ideal | A-405 | S. B. open |
| 4 | 60 | Ideal | AH-444 | S. B. open |
| 2 | 60 | L. A. | OGA-444 | S. B. drip proof |

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|---|---|---|
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| 3— | 333 KVA G-E | 33000—2300/6900 |
| 3— | 333 KVA G-E | 33000—2300/4000Y |
| 3— | 333 KVA Mol | 7200/12470Y—2400/4160Y |
| 3— | 333 KVA W-H | 6600—2300 |
| 3— | 200 KVA G-E | 2400/4160Y—120/240 |
| 3— | 150 KVA G-E | 44000—600/2400 |
| 3— | 150 KVA G-E | 19050/33000Y—2540/4400Y |
| 3— | 100 KVA G-E | 33000—6900/11950Y |
| 3— | 50 KVA A-Ch | 33000—2400/4160Y |
| 1— | 500 KVA W-H | 27600—444/131 3-ph. |
| 1— | 450 KVA Penn | 14520/13200—2400 3-ph. |
| 1— | 150 KVA G-E | 7620/13200Y—120/208Y 3-ph. |

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Cross Drum Sinuous Headed straight tube type. Heating surface 11417 sq. ft.—1141.7 HP—210 P.S.I.G. design pressure—200 P.S.I.G. working pressure—75,000 lbs./hr. capacity—steam temp., saturated—1024 cu. ft. furnace volume —200° feed water temperature.

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ASME code—from ATR tug—built 1943. 15,000 lbs. steam/hr./unit (normal) 18,000 lbs. steam/hr/unit max. Design pressure—268 lbs/sq. in. —total steam at drum outlet (saturated) 409 —forced draft—turbine driven blowers—1508 sq. ft. boiler heating surface. Gas or oil.

**(4) 300 KW G.M. 8-268A DIESEL GEN.**

G.M. diesel generator sets—120/240 volts DC —1200 RPM—1250 amps.—8 cyl. 6½x7—with switchgear.

**(2) 60 KW CUMMINS DIESEL GEN.**

120/240 volts DC—250 amps.—Model H engine —6 cylinder—heat exchanger cooled.

**(2) 100 KW GM 3-268A 440/60/3 AC generator sets.**

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**75 KW WAUKESHA DIESEL GEN.**

Heavy duty—totally enclosed—with built-in switchgear. 75 KW — 230 volts DC. 6 cyl. Waukesha diesel, 160 HP, 1200 RPM. Radiator cooled.

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| 1250 | Al.Ch. | 480 | 900 |
| 250 | C.W. | 250 | 1200 |

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| 4—500 | WH. | 600 | 1200 |

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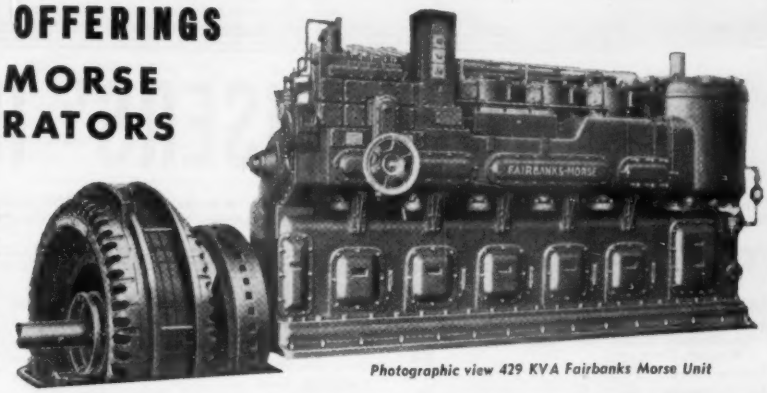

*Photographic view 429 KVA Fairbanks Morse Unit*

**Complete Installations**

**500 HP Fairbanks Morse Diesel engine Model 33-F-12, 5 cylinders, 400 RPM. 14" bore, 17" stroke direct connected to a:**

**429 KVA—343 KW, 80% PF, F. M. generator 3/60/2400 volts. *LIKE NEW. INSTALLED 1948.***

**690 HP Fairbanks Morse Diesel engine Model 33-E-14, 6 cylinders, 300 RPM, 14" bore, 17" stroke direct connected to a:**

**592 KVA—473 KW, 80% PF, F. M. generator, 3/60/2400 volts. *EXCELLENT CONDITION INSTALLED 1949.***

**225 HP Fairbanks Morse Diesel engine Model 32-E-14, 3 cylinders, 300 RPM. 14" bore, 17" stroke direct connected to a:**

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| H.P. | Make | Type | Volts | R.P.M. |
|---|---|---|---|---|
| 600 | West. | CS10238H | 2300 | 1450 25 Cy. |
| 250 | Cr. Wh. | SC-68R | 208 | 1750 |
| 200 | G.E. | KT-564 | 440 | 720 |
| 150/75 | G.E. | IK-17 | 440 | 600/300 |
| 150 | G.E. | I-K | 440 | 1750 |
| 125 | G.E. | I-K | 2300 | 1750 |
| 125 | G.E. | K-6328 | 440 | 3600 TEFC |
| 75 | G.E. | KT-343 | 2300 | 1150 |
| 60 | A.C. | AR | 440 | 3600 BB |
| 50 | G.E. | I-K | 220 | 850 |
| 25 | G.E. | KF365 | 440 | 352 G.H. |

### SYNCHRONOUS MOTORS

| H.P. | Make | Type | Volts | R.P.M. |
|---|---|---|---|---|
| 700 | G.E. | AQI | 2300 | 720 |
| 700 | West. | Ped. | 2300 | 900 |
| 600 | G.E. | TS984Z | 2300 | 360 |
| 500 | G.E. | TS7657 | 2300 | 514 |
| 400 | West. | "HG" | 2300 | 1800 |
| 300 | A-C | 70% | 2300 | 1200 |
| 250 | G.E. | TS7653 | 2300 | 600 |
| 200 | West. | "HG" | 440 | 1800 |
| 930 | G.E. | ATI | 2300 | 136 |
| 804 | G.E. | ATI | 2300 | 150 |
| 187 kva | A-C | 80% | 2300 | 400 |
| 125 kva | West. | "G" | 460 | 600 |
| 125 | E-M | Ped. | 2300 | 400 |
| 125 | E-M | Ped. | 2300 | 360 |
| 100 | G.E. | TS6214 | 208 | 300 |
| 200 | E-M | 1 PF | 6000 | 720 |
| 82 | G.E. | ATI-E | 2300 | 327 |
| 75 | E-M | 1 PF | 220 | 720 |
| 50 kw | West. | "G" | 440 | 1200 1 PH |
| 50 kva | E-M | 80% | 120/208 | 1800 BB |
| 37 kva | ATI | G.E. | 120/208 | 1200 |

### SLIP-RING MOTORS

| H.P. | Make | Type | Volts | R.P.M. |
|---|---|---|---|---|
| 500 | A-C | ARY | 2300 | 505 |
| 500 | G.E. | I-M | 2300 | 900 |
| 350 | G.E. | IM-17B | 2300 | 600 |
| 250 | G.E. | IM-17A | 550 | 514 |
| 60 | G.E. | MT-546 | 440 | 850 |
| 30 | WAG. | 15-V | 220 | 1750 |
| 20 | G.E. | M-364 | 440 | 1750 |
| 2 | West. | CW234 | 440 | 1150 |

### TRANSFORMERS—60 Cy.

| KVA | Make | Voltage | |
|---|---|---|---|
| 1635 | West. | 3/4160 x 1368 | Rect. |
| 1200 | West. | 3/4160 x 2300 | Auto 3/2 PH |
| 455 | West. | 3/2600 x 1370 | Rect. |
| 350 | G.E. | 24,000 x 485 | Rotary |
| 333 | West. | 25/11,500 x 460 | |
| 333 | Pitts. | 22/11,000 x 2300 | |
| 165 | G.E. | 33,000 x 445 | Rotary |
| 100 | G.E. | 3/2300 x 4000 | Auto |
| 100 | A-C | 12,000 x 120/240 | |
| 100 | West. | 13,200 x 445 | Rotary |
| 75 | G.E. | 3/2300 x 4000 | Auto |
| 50 | G.E. | 2400 x 120/240 | HS |
| 37.5 | G.E. | 2400 x 120/240 | HS |
| 25 | G.E. | 2400 x 120/240 | HS |
| 15 | G.E. | 2400 x 120/240 | HS |
| 10 | West. | 12,000 x 120/240 | |
| 7.5 | Wag. | 2300 x 230/460 | |

### M-G SETS AND CONVERTORS

| KW | Make | |
|---|---|---|
| 150 | West. | 3/60/2300 x 275 1200 RPM |
| 250 | C-W | 3/60/4000 x 250 1200 RPM |
| 400 | West. | Conv. Ped. 250 V. 1200 RPM |
| 500 | G.E. | Conv. HCC6 250 V. 1200 RPM |
| 750 | G.E. | Conv. HCC6 600 V. 1200 RPM |

### DIRECT CURRENT MOTORS & GENERATORS

| | | | | |
|---|---|---|---|---|
| 500 KW | G.E. | MPC | 600/250 V. | 900 RPM |
| 250 HP | G.E. | MCF | 600/250 V. | 300/685 |
| 250 HP | West. | SK153.5 | 230 | 2700 BB |
| 200 HP | G.E. | MD420 | 600/250 | 435 |
| 60 HP | West. | MCA60 | 230 | 460 Series |
| 60 KW | West. | SK-121 | 300 V. | 1200 Series |
| 30 HP | West. | SK-123 | 230 | 850 |
| 25 HP | West. | SK-123 | 550 | 1150 |
| 20 HP | West. | SK-97 | 230 | 850 |
| 20 HP | West. | SK-93 | 230 | 1750 TEFC |
| 20 HP | Star | Gear | 230 | 28 Enc. |
| 15 HP | G.E. | CD75 | 230 | 150 G.H. |
| 15 HP | West. | SK63 | 550 | 1750 |
| 15 HP | West. | SK63.9 | 550 | 1150 |
| 7.5 HP | Rel. | 14-T | 2300 | 1600 |
| 5 HP | G.E. | B284 | 230 | 1150 Ser. Tefc |
| 5 HP | G.E. | B-254 | 230 | 1150 |

### MISCELLANEOUS AND SPECIALS

1500 KW West. Rectifier, 1500 V. D.C. 3/60/44,000 Auto. Railway Sub.
6585 CFM I-R PRE2—42/25-½ x 30 Synch
5820 CFM I-R PRE2—40/24 x 27 Synch.
1600 CFM Worth 20/12 x 14 Steam
1300 CFM XRE I-R 20/12½ x 14 Synch
1100 CFM Clark 4 cyl. 12 x 11 60 Psi Synch
140 CFM Penna Duplex 5½ x 10 Synch
300 TON Worthington, Freon Compressors 2 Cyl. 13 x 10, 360 RPM—New in 1945
100 TON York Freon Compressor 2 Cyl. 12 x 9, 100 HP Synch Drive
300 KVA G. E. Steam Turbine 3/60/2300
150 HP Cummins Diesels "LI," 4 Cyl.
187 KVA Chi.-Pneu Diesel Plant 3/60/2300
50 KW Int. Harv. UD-18 Portable 3/60/20
25 KW Oil Well Supply Diesel Sets
35 Ton CRANE, Hand Oper. 42'10" Span
35 HP Phila. Speed Reducers 1750/114 RPM
60 HP Link-Belt Speed Reducers 850/30
225 HP West. Synch. Auto Panels
CI. 14-250
600 HP GE CR7051 Auto Comps. 2300 V.
150 HP BUDA Diesels, 6PCD-1742
200 HP F & M Mod. 35, Dir. Rev. 6 Cyl.

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1430 FRANKLIN AVE. ST. LOUIS 6, MO.

TELEPHONE CHESTNUT 4838

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*...for the world's finest gauge:*

# . . . the world's finest movement

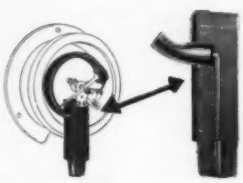
To actually become the standard of comparison in its field, a product must be better; not just in some ways, but in *all* ways.

A particularly good example of such a product is the Marsh Master-gauge. By giving industry a gauge that is better in *all* ways, it has become the recognized standard of comparison in the pressure gauge field.

The movement illustrated here represents just one way—but a very important way—in which the Mastergauge excels. In a pressure gauge, the movement has the vital assignment of converting the action of the bourdon tube into accurate pressure indication. To do this unfailingly, a movement must be ruggedly constructed, practically frictionless and highly resistant to corrosion.

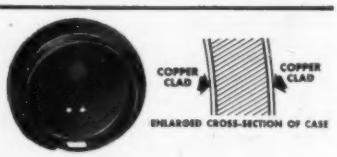
All of these attributes are ideally combined in the Master gauge movement. A self-lubricating, frictionless effect is achieved by using alternate stainless steel and monel throughout . . . gears, hardened stainless; bushings, "K" monel, and so on through all moving parts. A particularly outstanding feature contributing lasting accuracy is the "coined" sector gear. Note the broad face which results from this coined extrusion of the gear blank.

Yes, features like these, along with precision machining, painstaking assembly, and thorough-going testing, makes a better-in-all-ways movement for a better-in-all-ways gauge. Ask for up-to-the-minute information.



**A better tube construction...**

***"Connoweld"*** A truly revolutionary development is the joining of the socket, bourdon tube, and end-piece into a one-piece unit in the Marsh Mastergauge. The photo of a socket cut in half shows the perfect fusion at the point where too many gauges leak. A special Marsh process — the Connoweld Process — makes this possible.




**A better Case . . .**

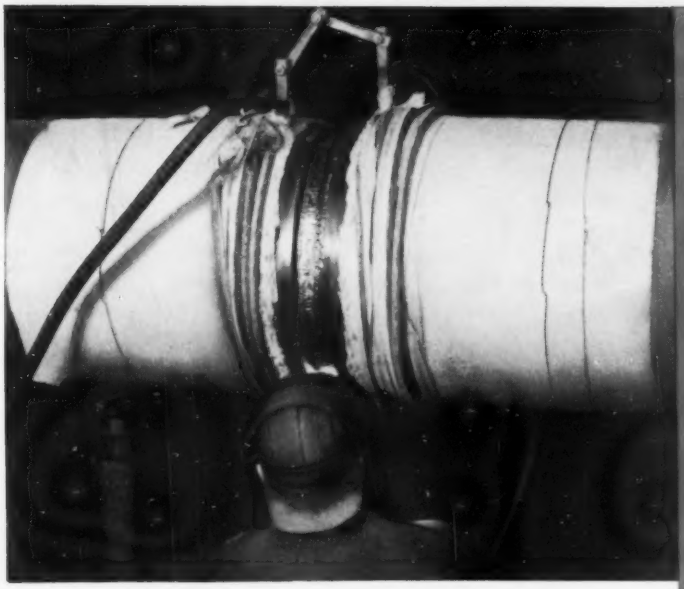
***"Marshalloy"*** Another recent development that has increased Mastergauge leadership is the copper-clad, wrought steel case. Copper surfaced by the Marsh-developed "Marshalloy" process, the case is attractive and non-corrosive. It is four times as strong and one-third lighter than conventional cast iron case!

**MARSH INSTRUMENT CO.,** *Sales affiliate of Jas. P. Marsh Corporation*
**Dept. F, Skokie, Illinois**
**Export Dept., 3501 Howard St., Skokie, Ill.**

# MARSH GAUGES

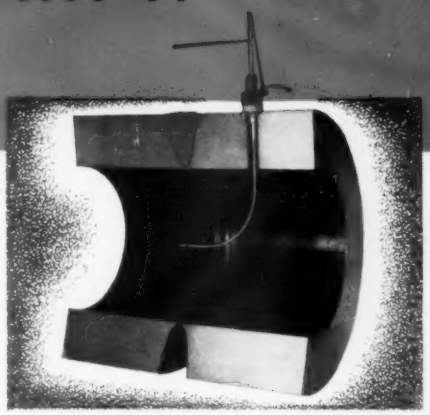
"THE STANDARD OF ACCURACY"

**Thermometers • Water Regulating Valves • Solenoid Valves • Heating Specialties**



# SHOP WELDING 4" WALL PIPE

## for steam at 2050 PSI and 1050° F!



A test piece of 4" wall pipe cut apart to show the quality of the weld. Also illustrated is the method used to introduce a radium capsule into the center of a completed assembly for radiographic examination of the weld.

**You can be confident** of the piping fabricated in Grinnell shops, because Grinnell Research predetermines materials and methods, then checks results to insure that specifications are met exactly.

**An example of the thoroughness** of Grinnell Research is the preparatory work which was done to insure the performance of the piping shown above. This sub-assembly is being fabricated from 4" wall pipe forged from 2¼% chrome, 1% moly steel. To withstand the high pressure and temperature of this installation, Grinnell Research specified the fabricating and welding procedures to be used. This included the time and temperature cycles for preheating and stress relieving, and the correct type of electrodes.

**Preliminary test welds** on sample pipe were made. These were then cut apart and analyzed to check microstructure and strength of the weld, which had to have the same properties as the pipe itself.

Taking photomicrograph of specimen of a test weld.

**During fabrication,** the first inch of each weld was ground smooth and given a complete radiographic examination for possible flaws. Finally the completed weld was checked by radiographic examination.

**It's intricate business** . . . developing correct fabrication methods for new materials and services. It's one of the jobs for which Grinnell fabrication specialists are well qualified, because Grinnell has the equipment and modern methods, the interpretive engineering, the metallurgical research facilities and the skilled personnel to handle any prefabrication requirement.

# GRINNELL

**WHENEVER PIPING IS INVOLVED**

**Grinnell Company, Inc., Providence, Rhode Island** • **Coast-to-Coast Network of Branch Warehouses and Distributors**

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

# Preventing high-volt leaks with PERMUTIT demineralized water

THE 75′ diameter atomic accelerator shown below has five times more power than any other. Its 2200 ton electromagnet quickly whips particles three million times 'round the race-track to an energy approaching 3 billion electron volts.

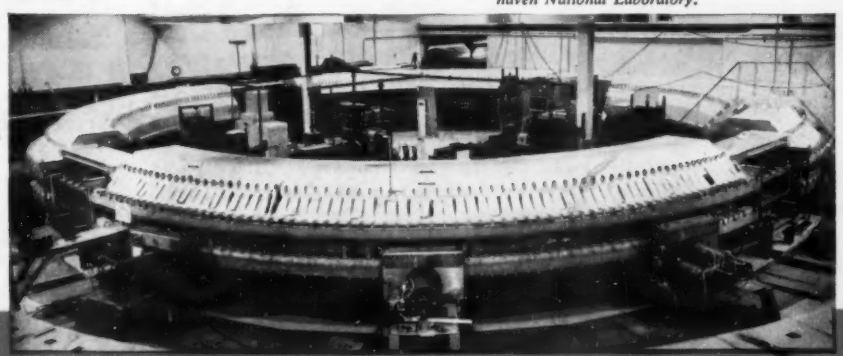
Packing all this power into a reasonable-size unit was a problem. Size ruled out air cooling. So the bus-bar magnet coil was made for circulating cooling water.

But at 3,000 volts, the dissolved minerals in *untreated* cooling water could conduct electricity, causing appreciable leakage to grounded piping. A means had to be found for producing water purer than conventional distilled water—at low cost.

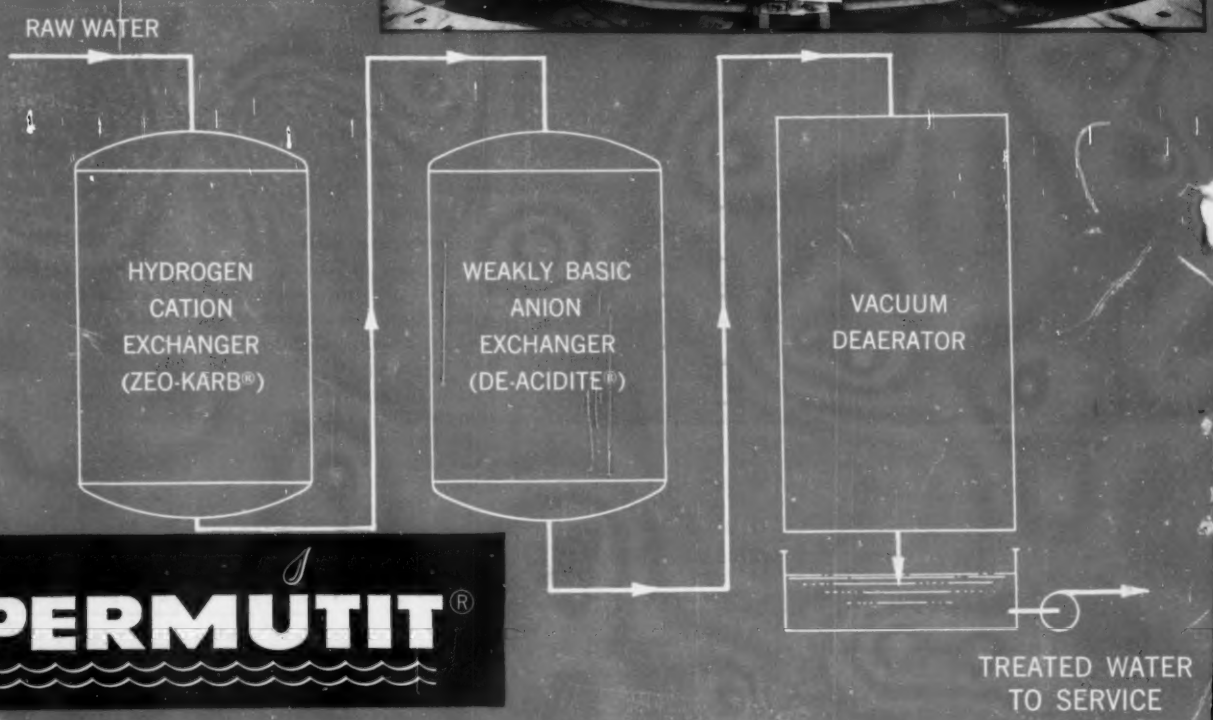
A Permutit Demineralizer was selected *(see diagram)*. Cooling water recirculated through this ion exchange unit approaches the very low conductivity of pure water, hence it has been completely effective in removing dissolved solids.

Find out how Permutit can solve your water problems. Write to THE PERMUTIT COMPANY, Dept. P-2, 330 West 42nd Street, New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

*The giant Cosmotron at Brookhaven National Laboratory.*



*Permutit two-step Demineralizer with Vacuum Deaerator. Troublesome cation impurities are removed in the first step, remaining minerals in the second, oxygen and $CO_2$ in the final.*




PERMUTIT®

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS FOR OVER 40 YEARS